Annals of the Academy of Romanian Scientists
Online Edition Series on Agriculture, Silviculture and Veterinary Medicine Sciences
ISSN 2344 – 2085 Volume 1, Number 2/2012

ALTERNATION OF CROPS, SOIL FERTILITY AND FERTILIZATION-CRUCIAL COMPONENTS FOR SUSTAINABLE DEVELOPMENT OF AGRICULTURE

Boris Pavel BOINCEAN[1]

Abstract. *The article includes data from the long-term field experiments on chernozem soils from Balti steppe, Republic of Moldova regarding the efficiency of crop rotations and fertilization for different crops. It was established a lower efficiency of fertilization in crop rotation with higher diversity of crops. The share of soil fertilization in yield formation is increasing significantly in permanent crops. Higher yield potential for new, more intensive varieties of winter wheat can be achieved only in crop rotation with higher level of soil fertility. Respecting crop rotations and a proper management of soil fertility are the basis for transition to a more sustainable farming system in the Republic of Moldova.*

Key words: crop rotation, soil fertility, fertilization, sustainable agriculture, field crops.

1.Introduction

The industrialization of agriculture based on intensive use of inputs from nonrenewable sources of energy and their derivates have neglected the main agronomic laws (crop rotation; returning of nutrients and energy back in the soil; minimum, maximum and optimum etc). As a result many economic, ecologic and social consequences have appeared, which unfortunately are not evaluated properly or are externalized in the market economy, because of the dominated profit orientation.

Nevertheless, limited amount of nonrenewable sources of energy and increased prices for them, together with negative impact on the environment, including climate changes and health of people are reversing the industrial approach to agricultural intensification. This approach didn’t achieve a sustainable development of agriculture. That’s why many farmers and research organizations in all over the world are looking for alternatives to industrial model of agricultural intensification.

In this paper we present the results obtained in the long term field experiments with crop rotations and permanent crops, which are proving the significance of soil fertility and crop rotations for modern farming systems with less dependence from industrial inputs.

[1] Prof., PhD, Head of the Department of Sustainable Farming Systems , Research Institute of Field Crops “Selectia”, Balti, Republic of Moldova, E-mail: bboincean@gmail.com

2.Materials and Methods

Long-term field experiment with ten fields crop rotations was established in 1962 at the Research Institute of Field Crops “Selectia”, Balti, Republic of Moldova. The experiment includes 8 crop rotations, in three repetitions, with different levels of saturation with raw crops – from 40 up to 70%. Simultaneously researches are conducted in permanent crops of winter wheat, corn for grain and black fallow on fertilized and unfertilized plots since 1965, without repetitions. The other permanent crops have been reestablished in 1984. Researches in a new long-term field experiment on ecological agriculture with seven fields began in 1989, which includes two crop rotations (with and without mixture of perennial leguminous crops and grasses) on four backgrounds of fertilization (without fertilization, manure, manure + PK and manure + NPK).
The size of the experimental plots in the long-term field experiment with different crop rotations consists 283 sq.m., in the experiment with permanent crops – 450 sq. m. and in the long-term field experiment on ecological agriculture - 220 sq.m.
More details regarding the design of the long-term field experiments can be found in our previous publications [1, 2].
The soils on the experimental field are represented by typical chernozem on heavy clay. The content of soil organic matter for 0-20 cm soil layer determined by Tiurin method consists – 4,8-5,0%; pH in water and salt extractions – 7,3 and 6,2 respectively; the total content of nitrogen, phosphorus and potassium – 0,21-0,25%, 0,09-0,11% and 1,22-1,28%, respectively; the content of mobile form phosphorus and potassium (by Ciricov method) – 130-150 and 160-180 mg/kg of soil, respectively.
The varieties and hybrids of cultivated crops are included in the Register of crops for the Republic of Moldova. The technologies of growing field crops are recommended for the Republic of Moldova.

3.Results and Discussions

Yields of field crops are higher in crop rotation with a larger diversity of crops, both on fertilized and unfertilized plots (tab.1). Unfortunately during the era of “green revolution” the number of fields in crop rotations and simultaneously the diversity of crops in crop rotations have been reduced up to monoculture. The expectations from narrow specialized crop rotations, with lower diversity of crops, have been related to higher rates of mineral fertilizers and pesticides for weed, pest and desease control.
Data from Table 1 A, B and C are proving the general tendency of higher relative yield increase under the influence of fertilization in permanent crops relatively to crop rotations with 7 and, especially, with 10 fields. So, yield increase from

organo-mineral fertilization in crop rotation relatively to permanent crops consisted, respectively:
-for winter wheat – 15.1-7.1% (0.67-0.27 t/ha) and 49.4% (0.89 t/ha)
-for sugar beet – 35.8-67.3% (10.58-14.24 t/ha) and 96.9% (7.64 t/ha)
-for corn for grain – 17.2-21.1% (0.84-0.91 t/ha) and 43.4% (1.49 t/ha)
-for sunflower – 80-23.6% (0.15-0.30 t/ha) and 13.9% (0.18 t/ha)
-for winter barley – 31.7-53.2% (0.92-1.17 t/ha) and 87.6% (1.48 t/ha)

Table 1A. The influence of fertilization in crop rotations and in permanent crops, average for 1994-2012, long-term field experiments at the Research Institute of Field Crops "Selectia", Balti, Republic of Moldova,
10 fields crop rotation

Crops	10 fields crop rotation			
	Unfert.	Fert	±, t/ha	%
Winter wheat	4.43	5.10	+0.67	15.1
Sugar beet	29.59	40.17	+10.58	35.8
Corn for grain	4.88	5.72	+0.84	17.2
Sunflower	1.87	2.02	+0.15	8.0
Winter barley	2.90	3.82	+0.92	31.7

Table 1B. The influence of fertilization in crop rotations and in permanent crops, average for 1994-2012, long-term field experiments at the Research Institute of Field Crops "Selectia", Balti, Republic of Moldova,
7 fields crop rotation

Crops	7 fields crop rotation			
	Unfert.	Fert	±, t/ha	%
Winter wheat	3.80	4.07	+0.27	7.1
Sugar beet	21.15	35.39	+14.24	67.3
Corn for grain	4.31	5.22	+0.91	21.1
Sunflower	1.24	1.57	+0.30	23.6
Winter barley	2.20	3.37	+1.17	53.2

Table 1C. The influence of fertilization in crop rotations and in permanent crops, average for 1994-2012, long-term field experiments at the Research Institute of Field Crops "Selectia", Balti, Republic of Moldova,
Permanent crops

Crops	Permanent crops			
	Unfert.	Fert	±, t/ha	%
Winter wheat	1.80	2.69	+0.89	49.4
Sugar beet	7.88	15.52	+7.64	96.9
Corn for grain	3.43	4.92	+1.49	43.4
Sunflower	1.30	1.48	+0.18	13.9
Winter barley	1.69	3.17	+1.48	87.6

The exception is sunflower, where the efficiency of fertilization is lower in permanent cropping than in crop rotations, which should serve as a subject for special studies.

We have determined also the effect of crop rotations on fertilized and unfertilized plots for different crops in the long-term field experiments with crop rotations and permanent crops at the Research Institute of Field Crops "Selectia" (Table 2 A and B).

Table .2 A. The effect of crop rotations for different crops on fertilized and unfertilized plots, average for 1994-2012, long-term field experiments at the Research Institute of Field Crops "Selectia", Balti, Republic of Moldova

10 fields crop rotation

	10 fields crop rotation							
	Unfertilized				Fertilized			
	crop rotation, %	perma-nent crop-ping	±, t/ha	effect of crop rotation, %	crop rotation, %	perma-nent crop-ping	±, t/ha	effect of crop rotation, %
Winter wheat	4.43	1.80	+2.63	146.1	5.10	2.69	+2.41	89.6
Sugar beet	29.59	7.88	+21.71	275.5	40.17	15.52	+24.65	158.8
Corn for grain	4.88	3.43	+1.45	42.3	5.72	4.92	+0.80	16.3
Sunflower	1.87	1.30	+0.57	43.8	2.02	1.48	+0.54	36.5
Winter barley	2.90	1.69	+1.21	71.6	3.82	3.17	+0.65	20.5

Table .2 B. The effect of crop rotations for different crops on fertilized and unfertilized plots, average for 1994-2012, long-term field experiments at the Research Institute of Field Crops "Selectia", Balti, Republic of Moldova

7 fields crop rotation

	7 fields crop rotation							
	Unfertilized				Fertilized			
	crop rotation, %	perma-nent crop-ping	±, t/ha	effect of crop rotation, %	crop rotation, %	perma-nent crop-ping	±, t/ha	effect of crop rotation, %
Winter wheat	3.80	1.80	+2.0	111.1	4.07	2.69	+1.38	51.3
Sugar beet	21.15	7.88	+13.27	168.4	35.39	15.52	+19.87	128.0
Corn for grain	4.31	3.43	+0.88	25.6	5.22	4.92	+0.30	6.1
Sunflower	1.27	1.30	-0.03	0	1.57	1.48	+0.09	6.1
Winter barley	2.20	1.69	+0.51	30.2	3.37	3.17	+0.20	6.3

The effect of crop rotation is the difference in yields between crop rotations and permanent crops for different crops both on fertilized and unfertilized plots.

The effect of crop rotation is significantly higher in crop rotation with 10 fields, than in crop rotation with 7 fields both on unfertilized and fertilized plots. So, the

effect of crop rotation on unfertilized plots consisted for different crops in 10 and 7 fields crop rotations, respectively:
-for winter wheat – 2.63 t/ha (146.1%) and 2.0 t/ha (111.1%)
-for sugar beet – 21.71 t/ha (275.5%) and 13.27 t/ha (168.4%)
-for corn for grain – 1.45 t/ha (42.3%) and 0.88 t/ha (25.6%)
-for sunflower – 0.57 t/ha (43.8%) and -0.03 t/ha (0)
-for winter barley – 1.21 t/ha (71.6%) and 0.51 t/ha (30.2%)
The effect of crop rotation on fertilized plots in 10 and 7 fields crop rotations is lower than on unfertilized plots for different crops and consisted respectively:
-for winter wheat – 2.41 t/ha (89.6%) and 1.38 t/ha (51.3%)
-for sugar beet – 24.65 t/ha (158.8%) and 19.87 t/ha (128%)
-for corn for grain – 0.80 t/ha (16.3%) and 0.30 t/ha (6.1%)
-for sunflower – 0.54 t/ha (36.5%) and 0.09 t/ha (6.1%)
-for winter barley – 0.65 t/ha (20.5%) and 0.20 t/ha (6.3%).
Fertilizers are reducing the positive influence of crop rotation, but it stil remain high enough for winter wheat and sunflower, especially, in crop rotation with 10 fields. Less reactive to crop rotation are corn for grain and winter barley.
Crop rotation and soil fertilization are crucial in determining the share of soil fertility in yield formation (Table 3).

Table 3. The share of soil fertility in yield formation for different crops in the long-term field experiments at the Research Institute of Field Crops "Selectia", average for 1994-2012, Balti, Republic of Moldova

Crops	10 fields crop rotation	7 fields crop rotation	Permanent cropping
Winter wheat	84.9	92.9	50.6
Sugar beet	64.2	32.7	3.1
Corn for grain	82.8	78.9	56.6
Sunflower	92.0	76.4	86.1
Winter barley	68.3	46.8	12.4

The higher is the diversity of crops in crop rotations, the higher is the share of soil fertility in yield formation for all crops, with the exception of sunflower. Permanent cropping is reducing soil functionality and as a results the share of soil fertility is decreasing, but the share of fertilization is increasing. It is cheaper from economic point of view to respect crop rotation with a higher diversity of crops than to compensate the lack of crop rotation by the excess of chemicals. By respecting crop rotation it is possible to prevent also degradation and pollution of soil and water resources.
As it was mentioned before, fertilization is less efficient in crop rotation with higher diversity of crops. Supplementary utilization of mineral fertilizers on plots with manure usually doesn't provide an significant increase of yields for majority of crops (Table 4).

Table 4. Productivity of crops (t/ha) under the influence of different systems of fertilization in crop rotation on ecological agriculture, average for 1994-2012, Research Institute of Field Crops “Selectia”, Balti, Republic of Moldova

Crops	Unfert.	Manure			Manure + NPK		
		t/ha	±, t/ha	%	t/ha	±, t/ha	%
Winter wheat	3.71	4.12	+0.41	11.0	4.05	+0.34	9.2
Sugar beet	20.74	33.28	+12.54	60.5	34.95	+14.21	68.5
Corn for grain	4.59	5.09	+0.50	10.9	5.16	+0.57	12.4
Sunflower	2.36	3.05	+0.69	29.2	3.34	+0.98	41.5
Winter barley	1.27	1.45	+0.18	14.2	1.57	+0.30	23.6

So, respecting crop rotation and maintaining soil fertility by proper management of soil organic matter allow to cut the use of mineral fertilizers. This is true also for pesticides for weed, pest and desease control. Our recent researches have proved the negative influence of mineral fertilizers relatively to organic and organo-mineral fertilizers by a sharp reduction of the stocks of soil organic matter for the whole soil profile [3].

Transition to a more sustainable farming system can be achieved in a crop rotation with larger diversity of crops and proper management of soil organic matter in order to provide a good soil health (soil quality).

New varieties and hybrids of field crops are very important in increasing their productivity, but yields are determined mainly by the level of soil fertility. Experimental data obtained in the long-term field experiments for less intensive (Odesa 51) and more intensive (recently registered) varieties of winter wheat have demonstrated that new, more intensive varieties of winter wheat have provided an extra yield of 11.9 and 13.1% in crop rotation on unfertilized and fertilized plots, respectively (tab.5). In the same time the extra yield for new varieties of winter wheat in permanent crop have consisted only 5.9 and 2.3%, respectively on unfertilized and fertilized plots.

Table 5. The effect of new, more intensive varieties of winter wheat in crop rotation and in permanent crops, average for 1994-2012, long-term field experiments at the RIFC “Selectia”, Balti, Republic of Moldova

Crop rotations, permanent cropping	Unfertilized				Fertilized			
	New, more intensive varieties	Odesa 51	±, t/ha	%	New, more intensive varieties	Odesa 51	±, t/ha	%
Crop rotation	4.43	3.96	+0.47	11.9	5.10	4.51	+0.59	13.1
Permanent crop	1.80	1.70	+0.10	5.9	2.69	2.63	+0.06	2.3

It means that new, more intensive varieties of winter wheat with higher yield potential can achieve their potential only in good conditions of growing, where the requirements to the technology of growing are respected.

Conclusions

(1)The effect of fertilization is higher in permanent crops and lower in crop rotations with higher diversity of crops.
(2)The share of soil fertility in yield formation for majority of field crops is increasing in crop rotations with higher diversity of crops relatively to permanent crops. Crop rotations and manuring are reducing significantly the beneficial influence of mineral fertilizers on yields of field crops.
(3)In crop rotations with higher diversity of crops it is possible to reduce inputs of mineral fertilizers and pesticides for weeds, pests and deseases control, which makes agriculture more sustainable.
(4)Yield potential for new, more intensive varieties of winter wheat can be achieved only in crop rotations with higher diversity of crops and with proper management of soil fertility.

References

[1]Krupenikov I.A., Boincean B.P., Dent D. The Black Earth. Ecological Principles for Sustainable Agriculture on Chernozem Soils. Springer, 2010 vol.10. 170 p.

[2]Boincean B.P. Ecological agriculture in the Republic of Moldova (crop rotation and soil organic matter), 1999, Chisinau, Science, 279 p. (Russian).

[3]Boincean B., Nica L., Stadnic S. Fertilization and soil fertility of typical chernozem from Balti steppe. Chisinau, Akademos, 2011, nr.1 (20), pp. 110-121 (Romanian).

[4]Koepf H.Herbert. Soil fertility in sustainable low input farming. Michael Fields Agricultural Institute, Buletin nr.3, 1992. 26 p.

PARTICULARITIES OF THE BIOCHEMISTRY OF THE GRAPE BERRIES OF VINE INTER-SPECIFIC HYBRIDS (*V.VINIFERA* L. X *M.ROTUNDIFOLIA* MICHX).

E. ALEXANDROV, B. GAINA[1]

Abstract. *The morphological and biochemical analysis effected on the grape berries of the vine inter-specific hybrids of 4th backcross (V. vinifera L. x M. rotundifolia Michx.) have shown the concentrations of phenolic substances, resveratrols, pectins etc. are relatively higher than in varieties of the cultivated vine (V. vinifera L.). However, the wild vine (Vitis vinifera subsp. silvestris Gmel.) has much more higher concentrations of phenolic substances, resveratrols, pectins etc. comparatively to those of vine inter-specific hybrids of 4th backcross (V. vinifera L. x M. rotundifolia Michx.).*

Keywords: berry, flavor, taste, resveratrol, pectin, sugars, pH, morphology.

1. Introduction

The morphological and biochemical analysis effected on the grape berries of the vine inter-specific hybrids of 4th backcross (*V. vinifera* L. x *M. rotundifolia* Michx.) have shown the concentrations of phenolic substances, resveratrols, pectins etc. are relatively higher than in varieties of the cultivated vine (*V. vinifera* L.).

However, the wild vine (*Vitis sylvestris* Gmel.) has much more higher concentrations of phenolic substances, resveratrols, pectins etc. comparatively to those of vine inter-specific hybrids of 4th backcross (*V. vinifera* L. x *M. rotundifolia* Michx.).

2. Materials and Methods

The plant material was composed of clusters of grapes and interspecific hybrids of the fourth backcross (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) (hybrids were obtained in the Laboratory of Dendrology Botanical Garden (Institute) of Academy of Sciences of Moldova), of *Muscadinia rotundifolia* Michx., *Vitis vinifera* L. (or vines planted), *Vitis sylvestris* Gmel. (or wild grape or vine wood).

[1] Prof., Acad., Practical Scientific Institute of Horticulture and Food Technology, Republic of Moldova (e_mail: bgaina@asm.md)

Morphological and biochemical analyzes were performed in Montpellier, France, using methods approved by the International Office of Vine and Wine [1999]. Morphological analyzes were carried out in the Laboratory of Dendrology Botanical Garden (Institute) of the Academy, such biochemical were carried out in the Laboratory of Quality control wines the National Institute of Vine and Wine of the Republic of Moldova and the National School of Agronomy of Montpellier, France, according to the method [2, 3, 9] approved by the International Office of Vine and Wine [1999].

3..Results and Discussions

Morphological and biochemical elements and clusters of grapes that have reached maturity, are shown in Table 1. Biochemical composition is very different from one genotype to another, both in quantitative and qualitative terms.

The following materials were assayed in berries vine total phenolics, resveratrols, pectin, organic acids and pH.

Biochemical analyzes performed according to methods approved by the International Office of Vine and Wine (1999) demonstrated a concentration of total phenolic compounds that varies among genotypes: 1970 mg/kg for hybrid berry blue-violet (DRX-M4-660), 597 mg/kg for hybrid pink berries DRX-M4-515), and the hybrid yellowish-green berries in intervals of 219 mg/kg (DRX-M4-520) until to 309 mg/kg (DRX-M4-545). This important biological indicator is a characteristic of the resistance against the attack of fungal parasites, bacteria, acetic, etc. phylloxera. Concerning the hybrid DRX-M4-660, with purple-blue berries, which contains 1970 mg/kg of phenolic compounds, it should be noted that over the contents of those noted in the varieties of Chismis Bujac (481 mg/kg), Kismis Moldova (399 mg/kg) and Pamiati Juraveli (511 mg/kg) determined in the years 2003-2007 at the National Institute of Vine and Wine of the Republic of Moldova [5, 6, 8].

In comparison with the inter-specific hybrids and species listed above, the wild vine (*Vitis sylvestris* Gmel.) With purple-blue berries contains 2019 mg/kg of phenolic compounds, which is absolutely remarkable.

Figure 1 shows all these results and highlights the hybrid DRX-M4-660 and *Vitis sylvestris* Gmel.

It is noted that in interspecific hybrids 4th generation backcrosses, there is also a relatively high concentration of resveratrol, from 4.9 mg/kg (DRX-M4-510) to 14.0 mg/kg (DRX-M4-660).

Resveratrol is also involved in resistance to pests and pests, as well as trap free radicals in the human body. In the hybrid grapes to dark violet-blue color, along with high concentrations of phenolic compounds 1970mg/kg (DRX-M4-660), relatively high concentrations of resveratrol 14.0 mg/kg were detected (DRX-M4-660).

As for phenolic compounds, resveratrol content, also very important, more than twice that of grapes *Vitis vinifera* L. If we consider the following varieties in the southern region of viticulture in Moldova for the years 2005-2007 in concentrations between 5 and 7 mg/kg were found for Cabernet Sauvignon, Merlot and Pinot -Black [6].

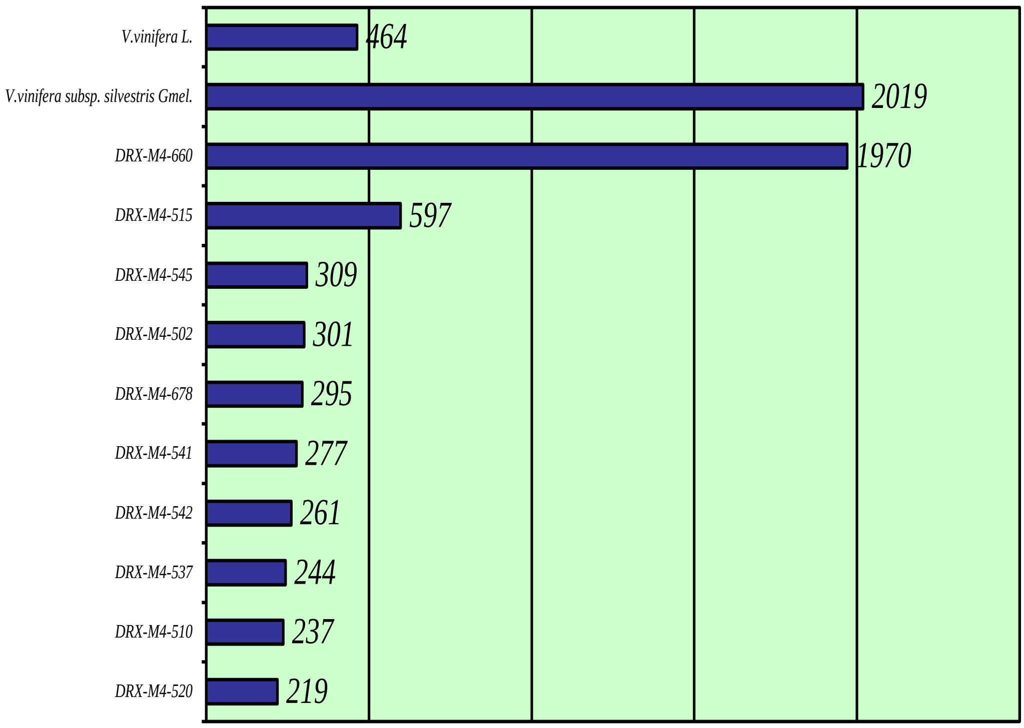

Fig. 1. Content of grape berry total polyphenols compounds (mg/kg) of inter-specific hybrids *V.vinifera L. x M.rotundifolia* and of *V. sylvestris* Gmel.

Wild vine *Vitis sylvestris* Gmel. has bays 16.0 mg/kg of resveratrol, which is here also quite noticeable, while the highest values are those of *Muscadinia rotundifolia* Michx. Figure 2 shows the overall results.

An equally important element for use in products œnothérapie interspecific hybrids for consumption pectins, which are dietary fiber, and are responsible for some balance in the blood of the human body, including the reduction of absorption through the intestinal wall of saturated fats and LDL cholesterol first (ie oxidized lipids that induce various adverse effects, according to Mr. Montignac, 2010). In interspecific hybrids were found in bays concentration of pectin varies in the range of 413 mg / kg (DRX-M4-520) up to 711 mg/kg (DRX-M4-515). Values of *Vitis sylvestris* Gmel. here are also remarkable. Figure 3 shows these results.

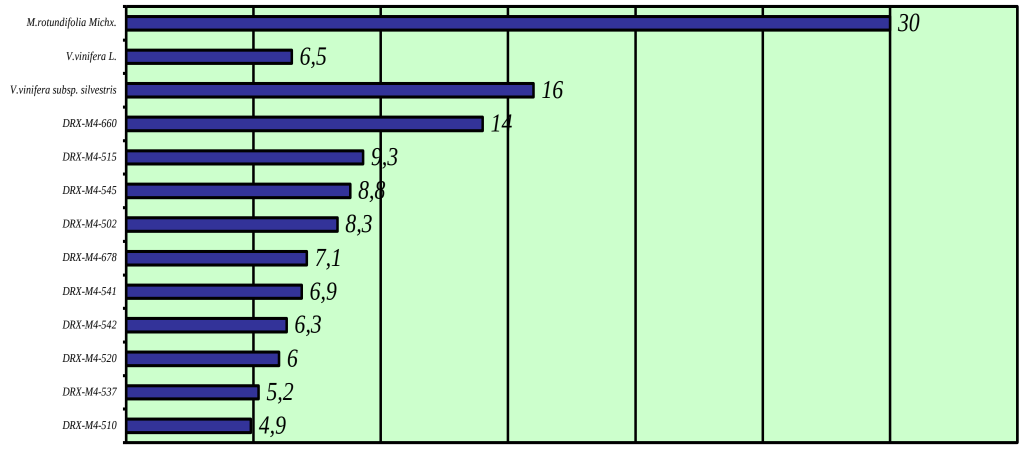

Fig. 2. Content of grape berry total resveratrols (mg/kg) of inter-specific hybrids *V.vinifera L. x M. rotundifolia* Michx., of *M. rotundifolia* Michx. and of *V.sylvestris* Gmel.

The human body receives substantially more than 50% of fiber needed by consuming an amount of 250-360 g of grapes (the rest of the input comes from the bread, vegetables etc.).

The analysis of the potential of the main organic acids in grapes - tartaric acid and malic acid - as well as those of titratable acidity and pH, attest to a normal presence of these in the total range of biological substances that influence taste, freshness and balance sensory components of interspecific hybrids of grapes 4th generation backcrosses *Vitis vinifera* L. x *Muscadinia rotundifolia* Michx. *Vitis sylvestris* Gmel. here is the usual standards. Figure 4 shows these values.

According to the results of biochemical analyzes conducted on berries of interspecific hybrids of grapevine (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) 4th generation backcrosses, it was found that their content in phenolic compounds, pectins or resveratrols is relatively higher than in the cultivated vine varieties (*Vitis vinifera* L.).

The American vine (*Muscadinia rotundifolia* Michx.) has an absolute resistance against phylloxera snout and the leaves (gall), and a series of resistance to fungal parasites major. It is logical to observe that the concentration of resveratrols totaiux reaches the limit of 30 mg/kg, and also that the total phenolic content and total pectins are higher than in the European vine (*Vitis vinifera* L.) is not resistant to phylloxera pest or fungal.

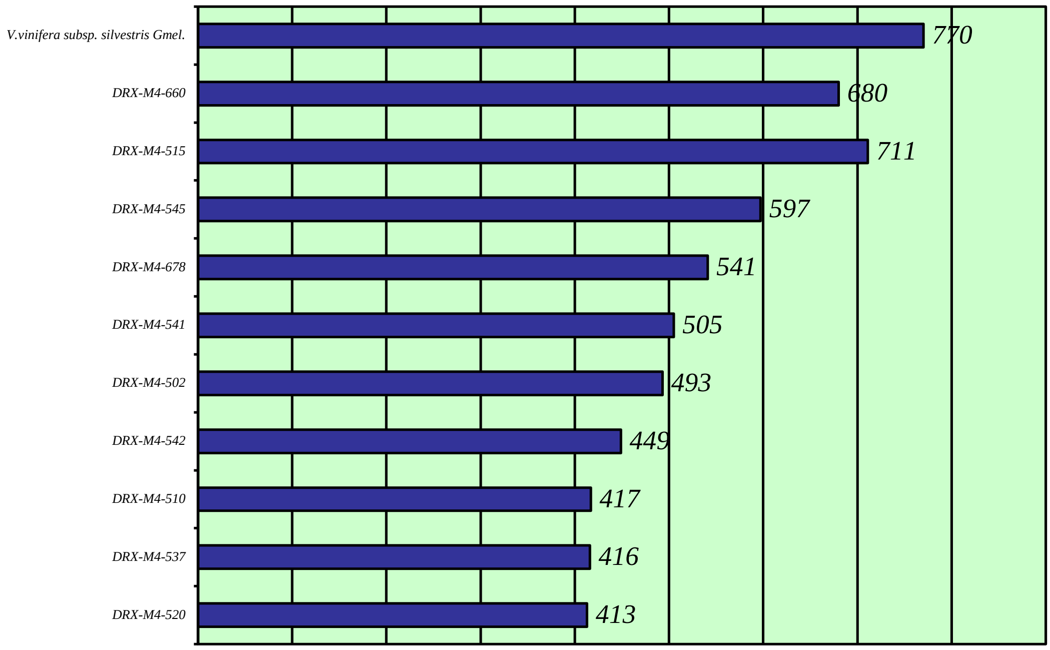

Fig. 3. Content of total pectins of inter-specific hybrids *V.vinifera L. x M. rotundifolia* Michx. and of *V. syilvestris* Gmel.

Interspecific hybrids (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) are not attacked by the phylloxera gall or snout, or by major fungal parasites. Their previous levels of the compounds is higher than the cultivated vine, may sless however, that for the parent resistance *Muscadinia rotundifolia* Michx.

But the result probably relates more original wild vine (*Vitis sylvestris* Gmel.) Which is not known to possess remarkable resistance to pests, parasites and pests above. Any time it is suitable for environments often difficult, and therefore probably has genes for tolerance to abiotic environmental stress. In any case it contains concentrations of phenolics, pectins and resveratrols much higher than interspecific hybrids, and therefore *Vitis vinifera* L.

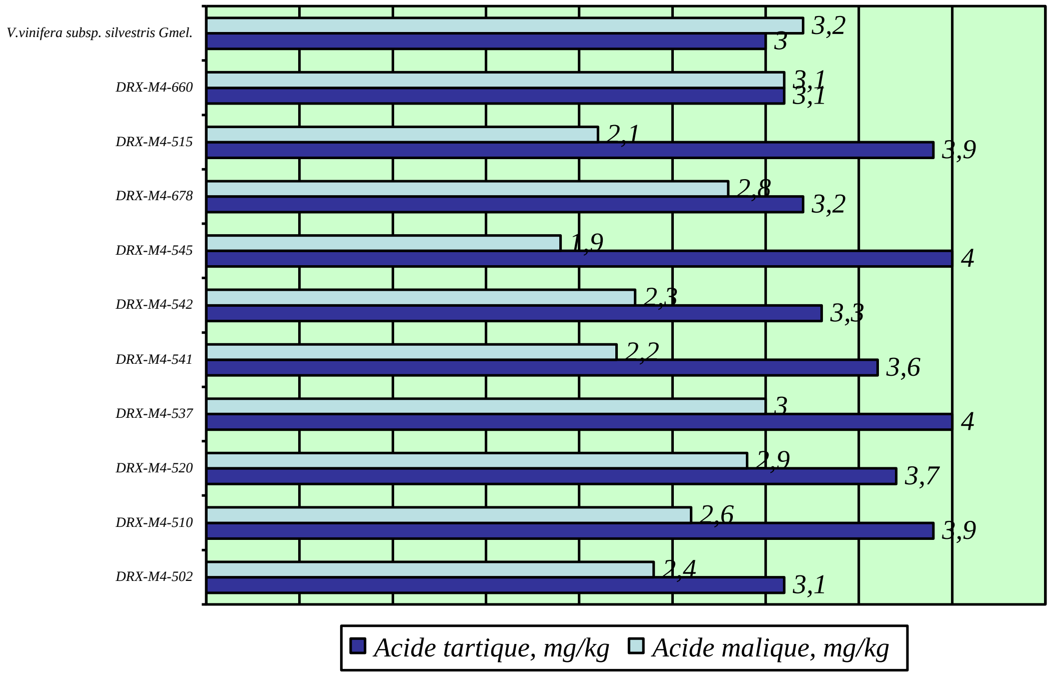

Fig. 4. Content (mg/kg) of malic acid and tartaric acid of inter-specific hybrids *V.vinifera L. x M.rotundifolia* Michx. and of *V. sylvestris* Gmel.

Conclusions

(1)Interspecific hybrids of grapevine (*Vitis vinifera* L. x *Muscadinia rotundifolia* Michx.) With berries yellowish green have total phenolic contents within: 219, mg/kg (DRX-M4-520) until to 309 mg/kg (DRX-M4-545) in resveratrols total 4.9 mg/kg (DRX-M4-510) to 8.3 mg/kg, and total pectin 413 mg/kg (DRX -M4-520) up to 597 mg/kg (DRX-M4-545); interspecific hybrids with pink berries (DRX-M4-515) hold: the total phenolic concentrations of 9.3 mg/kg, total resveratrols mg/kg, and total pectin 680 mg/kg and interspecific hybrids with berries blue-violet (DRX-M4-660) possess the total phenolic contents of 1970 mg/kg, resveratrols total 14.0 mg/kg and total pectin 680 mg/kg.
(2)Wild vine (*Vitis szlvestris* Gmel.) With berries of a blue-violet shade holds: the total phenolic content of 2019 mg/kg in total resveratrols 16.0 mg/kg and total pectins 770 mg/kg.
(3).American wild grapes (*Muscadinia rotundifolia* Michx.), Also having the berries of a blue-violet shade, holds bays resveratrols total concentrations of 30 mg/kg.

(4).Wild plants have a much higher resistance to biotic and abiotic environment that cultivated plants, but breeding can transmit these characters largely from parent *Muscadinia rotundifolia* Michx. As for the wild grape, *Vitis sylvestris* Gmel., a search would be interesting to develop in order to know their characteristics and possible interests.

References

[1] Alexandrov E. *Hibridarea distanţă la viţa de vie (V.vinifera L. x V.rotundifolia Michx.).* (Printr-Caro, Chişinău, Republica Moldova, 2010, 182 pag.).

[2] Heroiu Elena, Savulescu Georgeta, Racota Rodica. *Studii asupra resveratrolului, compus biologic activ*. Iu Link: http://www.univagro-iasi.ro/Horti/Lucr. St. 2005/63.

[3] Kolouchova-Hanzlikova, melzoch Karel, Filip Vladimir, Smidrkal. *Rapid method for resveratrol determination by HPLC with electrochemical and UV detections in Wines*. J. of Food Chemisty 87, 151-158 (2004).

[4] Alexandrov E. *L'hybridation distante* de la vigne *(Vitis vinifera L. x V.rotundifolia Michx.).* Revista Botanică. **II. 2.,** 148-154 (2010).

[5] Gaina B. *Struguri, vinul şi proprietăţile lor nutritive şi curative*. (Chişinău, Republica Moldova, 1999. 56 pag.)

[6] Gaina B., Roman O., Bourzeix R., Gougeon R. *Viticultura şi vinificiaţia în Moldova*. Chişinău, Republica, **3**, 24-25 (2007).

[7] Montignac Michel. *Vinul un aliment esenţial pentru sănătatea ta.* (Editura „Litera", Bucureşti, România, 2010, 238 pag.)

[8] Odăgeriu G., Niculana M., Cotea V., Gaina B., Zamfir C. *Study on the profile of antocyans from red wines obtained by different technological variants of maceration-fermentation.* Cercetări Agronomice în Moldova. Iaşi, România, **2 (130),** 41-53 (2007).

[9] Alexandrov E. *Otdalennie ghibridi vinograda Vitis vinifera L. x Muscadinia rotundifolia Michx.* Visnik Kiivsikovo Nationalinovo Universitetu Imeni Tarasa Sevcenco «Introductia ta zberegania roslinnovo riznomanittea», **19-21**, 29-30 (2009).

[10] Gaina B. *Anologhia i biotehnologhia productiov pererabotcki vinograda*. (Chisinau. Stiinta. 1990, 266 st.)

[11] Juan F. Mareno-Labanda, Ricardo Mallavia, Laura Pere-Fons, Victoria Lizama, Domingo Saura, and Vicente Micol. *Determination of Piceid and Resveratrol in Spanish Wines Deriving from Monastrell (Vitis vinifera L.) Grape Variety*. J. Of. Agric. Food. Chem.. **52**, 5396-5403 (2004).

Topala S. *Cariologhia, poliploidia i otdalennaia ghibridizatia vinograda*. (combinatul Poligrafic, Chisinau, 2008, 550 pag.).

EXPEDITURE OUTFLOW AND FOOD CONSUMPTIONS IN ROMANIA

Iulian ALECU[1], Elena SOARE[2], Marian CONSTANTIN[3]

Abstract. *The present work aims at investigating the trends of the expenses – expenditure outflow - so that the pattern and the amount of the food consummation should be figured out. The trends of the expenditure outflow is reflected by specific indexes: the operating costs included in the present study are total operating expenses, money expenses, food expenses and the internal expenses of the farmhouse. The influences of the operating costs of the producers induce a specific trend on the consumers of the main food products: grains and cereals, milk and dairy products, fish and meat and related products. Based on these indexes it is possible to run out and complete a certain degree of the food security in Romania. One starts from quantitative records: dynamic evolution of the quantum of consumed food products and related expenses. Also qualitative details are pointed out: the level and the cumulative flow rate that correlates the indexes expenses – consumed products.*

Key words: food consummation, expenditure outflow, food security, consumed food products, consumed expenses

1.INTRODUCTION

There are permanent changes in food guidelines from quantity to quality, for which reason a special role is played by factors influencing food consumption. They are very many in number, result not only from the field of agriculture, but have a much larger area. The variables themselves, such as the socio-demographic ones, represent the structure of a multitude of elements, including costs incurred

[1] Lecturer Ph.D., University of Agricultural Sciences and Veterinary Medicine of Bucharest, Romania, Email: iulian_alecu_2000@yahoo.com
[2] Lecturer Ph.D., University of Agricultural Sciences and Veterinary Medicine of Bucharest, Romania, Email:Elena_soare@hotmail.com
[3] Prof.Ph.D., University of Agricultural Sciences and Veterinary Medicine of Bucharest, Romania, Email:marianconstantin2001@yahoo.com

as a sizing result that raises the question of the availability of food and access to it, including all the knowledge of food safety. At the same time, in the current stage, food security is not only a health issue in terms of malnutrition, but also sustainable economic development, environmental, and trade issue.

Food consumption patterns are set using the population's income policies so it is necessary to know the two-dimensional implications and levels of expenditures ↔ food products consumption.

This aspect is discussed in this paper, starting from the quantitative aspects (progressive amounts of food products consumption and associated expenditures), to the qualitative ones (related to the level and intensity of the correlative influence of the expenditures →consumption indicators).

2.Materials and Methods

From a methodological point of view, in this paper, using comparative analyses, we aimed at describing, through a set of characteristics (variables), the differences/ homogeneity of the main agrifood products consumptions at national level in the interval 1998-2009. At the same time, we analysed the expenditures in terms of three levels, namely: overall household expenditures, food consumptions expenditures, the population's consumption monetary expenditures, of which the farmers' consumption monetary expenditures.

The statistical analysis at the level of indicators in physical, value and percentage units was made at the level of these indicators, as compared to the overall expenditures and the level in the reference year 1998. In the same comparative form we calculated the level of food expenditures for farmer households.

The approach to the issue required the use of methods to estimate the influence of the factors affecting the main food products consumption, and in this case we used the elasticity coefficients method. It was used in order to know the intensity of the factors (expenditures → consumption), which is why several comparative variables were taken into account, through which the food consumption is successively influenced by the overall consumption expenditures, the consumption monetary expenditures and the farmers' consumption monetary expenditures.

In the interval 2004-2009, the elasticity coefficients were calculated for the fixed comparison base (E) and the chain base (E'), the result being each variable's contribution to the food consumption evolution. The resulting phenomenon (y) was represented through the main food products consumption level, and the cause change phenomena (x), were represented through the structural level of expenditure types. The elasticity coefficient (E) was calculated using the calculus relation:

$$E=\frac{\Delta y}{y}:\frac{\Delta x}{x}$$ The meaning of symbols:

Δy is the absolute increase in quantifiable size for the effect phenomenon;

Δx - , the absolute increase in quantifiable size for the cause phenomenon;

- x, y -, the basic comparison level of the quantifiable sizes for the effect, respectively cause phenomenon.

The working methodology aimed at knowing the trend in expenditures which will allow us to know the structure of the consumption level and substantiate the level of ensuring food safety in Romania.

3.Results and Discussions

3.1.The evolution of food consumption for the main food products in Romania.

The Romanian population’s food consumption is an essential and direct aspect of living conditions. Thus, a first interesting issue was the average consumption level of the main food products and especially the variation in the annual dynamics 1998-2009. In *table 1,* it is presented the status of the food consumption trend.

Table 1. The annual average consumption of the main food products per capita in Romania

Product	MU	1998	2000	2005	2009
Cereal and cereal products	Kg	221,1	219,7	214,8	200,8
	% compared to 1998	100	99,36	97,15	90,81
Potatoes	Kg	84,1	86,5	98,0	93,1
	% compared to 1998	100	102,85	116,52	110,70
Vegetables and vegetable products	Kg	145,9	134,3	162,6	168,2
	% compared to 1998	100	92,049	111,44	115,28

Fruit and fruit products	Kg	45,8	44,5	75,9	62,3
	% compared to 1998	100	97,16	165,72	136,02
Vegetable fats	Kg	10,0	13,1	14,6	16,0
	% compared to 1998	100	131	146	160
Milk and dairy products	Liters	194,4	193,0	239,2	233,2
	% compared to 1998	100	99,27	123,04	119,95
Fish and fish products	Kg	3,0	2,6	4,5	4,8
	% compared to 1998	100	86,66	150	160
Meat and meat products	Kg	51,2	46,3	68,3	67,5
	% compared to 1998	100	90,42	133,39	131,83
Animal fats	Kg	3,4	3,4	3,6	3,9
	% compared to 1998	100	100	105,88	114,70

Data source: The Statistical Yearbook of Romania 2005-2010, NIS.

The following aspects were noticed:

- in cereals and cereal products there is an annual downward trend, the amounts for the average annual consumption decreasing by -9.19% (from 221.1 to 200.8 kg per capita);

- in other vegetal products (potatoes and vegetables/fruit products), there are differentiated annual increase trends. Respectively an upward trend in fruits and fruit products, followed by vegetables and vegetable products and potatoes (increases compared to 1998 amounting to +36.02%, +15.28% and respectively +10.70%);

- the dairy and meat products consumptions follows the same annual upward trends (from 194.4 to 233.2 litre per capita and respectively from 51.2 to 67.5 kg per capita). These levels from 2009 compared to 1998 are increases of +19.95% and respectively 31.83%;

- as for fish and fish products, the annual consumption dynamics is fluctuating. Thus, compared to 1998, in the interval 1999-2001 there was a decrease in consumption, and in the following interval there were successive increases that reach, in 2009, 4.8 kg per capita, which represents an increase of +60.0%;

- the evolution in the consumption of vegetal and animal fats for the interval 1998-2009 takes an upward trend, but at different rates. The increase in vegetal fats is very steep +60.0% (from 10.0 to 16.0 kg per capita), and in animal fats it amounts to +14.7% (from 3.4 to 3.9 kg per capita).

Synthetically, these main products in the food consumption structure reflect, on the one hand, a consumption patterns which decreases cereals and cereal products, with a significant increase in vegetal fats and fish, and an average increase in the other products. But the consumption levels are differentiated in the structure of consumer social groups. The existence of annual consumptions which record annual increase rates in vegetal and especially animal fats (of +60.0% and respectively +14.7%) reflects the amounts intended for those consumers who are below the income average (or at subsistence level), whose food purchase possibilities stagnate or even decrease.

3.2.The food consumption expenditures structure

The food consumption expenditures are characterised using ways of investigating the overall expenditures annual structure and an analysis using the successive delimitation: of monetary expenditures, of those for purchasing food and the value of agricultural products consumption from own resources.

With reference to the interval 2004-2009 in *table 2* are presented these expenditure levels, also according to number of persons per household (1…6 persons).

The following conclusions may be drawn:

- the ratio of overall monetary expenditures within the overall expenditures is increasing (from 77.5% in 2004 to 84.5% in 2009);

- with slight differences, the ratio of food purchase expenditures remains the same (between 22.6% and 22.0%);

- regarding the value of agricultural products consumption there is a decrease by -7.0% (from 22.5% in 2004, to 15.5% in 2009);

- in terms of the number of persons per household we notice a minimum expenditures level for the households with only one person and maximum levels for households with over three persons. It is worth mentioning the sharp decrease in the agricultural products consumption value from own resources for all the cases related to the number of persons per household.

Table 2.Overall household expenditures, grouped according to number of persons in Romania (% of the overall expenditures)

	Expenditure structure	Total	Of which: in households according to number of persons:					
			1 person	2 persons	3 persons	4 persons	5 persons	6 persons
2004	Overall monetary expenditures	77,5	75,8	75,8	82,7	80,4	71,5	66,4
	Food purchase	22,6	24,8	21,8	22,4	22,7	21,9	23,4
	Value of agricultural products consumption (own resources)	22,5	24,2	24,2	17,3	19,6	28,5	33,6
2005	Overall monetary expenditures	81,7	79,8	80,6	85,8	83,8	77,2	70,9
	Food purchase	23,0	24,9	22,6	22,6	22,6	23,4	24,7
	Value of agricultural products consumption (own resources)	18,3	20,2	19,4	14,2	16,2	22,8	29,1
2006	Overall monetary expenditures	83,0	80,8	81,6	87,7	84,6	78,5	73,3
	Food purchase	22,2	25,2	22,1	22,1	21,3	22,4	23,0
	Value of agricultural products consumption (own resources)	17,0	19,2	18,4	12,3	15,4	21,5	26,7
2007	Overall monetary expenditures	82,7	79,4	81,5	87,6	84,1	77,5	73,0
	Food purchase	22,0	25,1	21,5	21,6	21,8	21,6	22,5
	Value of agricultural products consumption (own resources)	17,3	20,6	18,5	12,4	15,9	22,5	27,0

2008	Overall monetary expenditures	84,6	82,5	83,9	88,6	85,9	79,3	75,5
	Food purchase	22,2	25,5	22,2	21,6	21,8	21,6	23,0
	Value of agricultural products consumption (own resources)	15,4	17,5	16,1	11,4	14,1	20,7	24,5
2009	Overall monetary expenditures	84,5	82,4	83,7	88,9	85,1	80,4	75,6
	Food purchase	22,3	25,9	22,0	21,7	21,6	22,4	23,5
	Value of agricultural products consumption (own resources)	15,5	17,6	16,3	11,1	14,9	19,6	24,4

The evolution of food consumption patterns is considered the main reason for these differentiations. This is one of the basic reasons for which the ratio of food consumption expenditures compared to overall expenditures is still taken into account. The percentage levels presented in *table 3* illustrate the comparative form aimed at comparing food purchases, agricultural products consumption from own resources and the value of agricultural products consumption from own resources in farmer households. The dynamics recorded by these levels in the interval 1998-2009 is presented in Table 3.

Table 3. Food consumption expenditures ratio within overall household expenditures in Romania (%)

	1998	2000	2005	2009
Food purchase and consumed beverages	23,8	22.,1	23,0	22,3
Value of agricultural products consumption from own resources	29,8	31,6	18,3	15,5
Value of agricultural products consumption from own resources from own resources in farmer households	54,7	60,3	45,0	44,6

Data source: The Statistical Yearbook of Romania 2005-2010, NIS; Overall monetary household expenditures = 100%.

The following aspects deserve to be mentioned:

- the ratio of expenditures on purchasing food and consumed beverages is slightly decreasing and reaches a minimum level in 2007 (22.0%), after which this level reaches 22.3% in 2009;

- regarding the value of agricultural products consumption from own resources, there is a huge decrease. If in 1998 the ratio was 29.8% in 2009 it reached 15.5% (therefore a decrease by -14.3%);

- the resources of agricultural products for own consumptions was monitored using the same percentage patters and a decrease was also noticed. This situation includes the very activities of the farmers' families for which this comparison in relative figures decreases by -10.1% from 54.7% in 1998 to 44.6% in 2009).

During the following stage, we raise the issue of deepening this knowledge using the comparison basis of consumption monetary expenditures. In the interval 1998-2009, there were noticed differences both in the overall consumption monetary expenditures, in purchasing food products, and in the food expenditures associated with farmer households. All these variation levels are presented both in terms of values and as percentages in *table 4.*

The following aspects were noticed:

- the existence of a high increase in consumption monetary expenditures;

- food products expenditures decrease by -8.4% (so that from a ratio of 44.1% in 1998 we arrive at 35.7% in 2009);

- the decrease in food expenditures is also maintained for farmer households but it is of only -5.0% (from 35.4% in 1998 to 40.4% in 2009).

This is how we draw the conclusion that there are differentiated annual rates for the consumption monetary expenditures on food products. Starting with the first years after the revolution, about 1/3 of the expenditures incurred by retired and employed persons derived from agriculture, therefore they were not subject to the agrifood market.

Table 4. The structure of consumption monetary expenditures incurred by households in Romania

	MU	1998	2000	2005	2009
Overall consumption monetary expenditures of which:	lei/person	962602	1754878	720,27	1275,03
of which: for food products	lei	424507,5	724764,6	264,3391	455,1857
	% within overall expenditures	44,1	41,3	36,7	35,7
of which: food expenditures for farmer households	lei	222908,5	392472,5	169,83	306,26
	% within overall expenditures	35,4	37,8	40,8	40,4

Source: The Statistical Yearbook of Romania 2005-2010, NIS

At the next stage, the fundamental consumption in the interval 1998-2009 proves that, as compared to the overall expenditures on food products, there is an overall decrease of -8.4%, and of only -5.0% for farmers' families. All these imply substantiations related to, on the one hand, the income level which triggers higher expenditures especially on food consumptions, and on the other hand, the changes/progress from the rural to the urban consumption pattern. The differentiation in consumption patterns (rural and urban) is characterised by the access to food which is mainly limited by the household's purchasing power. At the same time, the rural pattern includes those categories of consumers who own terrain and whose food status depends both on their own production and on their purchasing power, determined by the ratio of sold products prices and the prices of products purchased on the market.

3.3.Analysis of the expenditures impact on consumptions for the main agrifood products

In order to causally know the differences presented above, we consider it necessary to analyse the correlative structure of indicators, by comparison and in evolution. Through specific determinations, elasticity manages to capture the level and impact of the expenditures factor on consumption. Elasticity coefficients were calculated, estimating the impact of expenditures (farmers' overall expenditures, overall monetary ones and consumption ones) on the consumption of main food items (cereals and cereal products, milk and dairy products, fish and fish products, meat and meat products). The elasticity coefficients with fixed base (E) the year 2004 and chain base (E'), presented in *table 5*, illustrate the direction and correlative impact.

Table 5.Elasticity calculated according to the correlative structure between expenditures (x) and the consumption of main food items in Romania (y)

	Cereals and cereal products		Milk and dairy products		Fish and fish products		Meat and meat products	
	E	E'	E	E'	E	E'	E	E'
Correlative structures between overall household expenditures (x) and the consumption of main food items in Romania (y)								
2004	0	0	0	0	0	0	0	0
2005	-0,26	-0,26	0,014	0,14	1,54	1,54	0,47	0,47
2006	-0,22	-0,27	0,13	0,25	0,73	0,18	1,60	2,01
2007	-0,12	-0,03	0,12	0,15	-0,16	-1,80	0,04	-2,26
2008	-0,08	-0,07	0,08	0,04	0,03	0,51	0,02	-0,007
2009	-0,09	-0,24	-0,02	-1,42	0,24	2,58	0,03	0,20
Correlative structures between household consumption monetary expenditures (x) and the consumption of main food items in Romania (y)								
2004	0	0	0	0	0	0	0	0
2005	-0,13	-.13	0,007	0,007	0,90	0,90	0,25	0,25
2006	-0,16	-0,24	0,099	0,23	0,55	0,16	1,14	2,39
2007	-0,11	-0,03	0,10	0,15	-0,14	-1,35	0,03	-1,61
2008	-0,07	-0,05	0,07	0,03	0,02	0,43	0,018	-0,005
2009	-0,08	-0,02	-0,02	-1,11	0,21	2,64	0,02	0,17

Correlative structures between farmers' consumption monetary expenditures (x) and the consumption of main food items in Romania (y)								
2004	0	0	0	0	0	0	0	0
2005	-0,17	-0,17	0.01	0,01	1,21	1,21	0,33	0,33
2006	-0,24	-0,37	0,14	0,36	0,80	0,25	1,66	3,69
2007	-0,14	-0,03	0,14	0,16	0,18	-1,43	0,04	-1,70
2008	-0,0,09	-0,05	0,08	0,035	0,03	0,47	0,02	-0,006
2009	-0,0,08	-0,09	-0,02	-0,50	0,22	1,19	0,02	0,08

From the figures presented above, the following aspects have to be mentioned:

- the interpretations of the overall household expenditures (x), on the consumption of main food items (y), show the trend through which the increase in expenditures influences the decrease in cereals and cereal products consumption (E<0; E'<0). For milk and dairy products, meat and meat products the coefficients in most years vary between 1 and 0 (1>*E*> 0; 1>*E*'> 0), which indicated a lack of elasticity (therefore the consumption level does not depend directly on the expenditures variation). In certain years, for the chain base (the comparison being relative to the previous year), there is a reverse elasticity as well (E<0; E'<0), which explains the status of the market which, for the respective products (milk, fish, meat), was favourable to the consumer;

- the influence of the household monetary expenditures (x) on the same consumer products structure (y), exhibits the same trends. In the case of cereals and cereal products, there is reverse influence (E<0; E'<0), and in the case of the other products there is lack of elasticity (1>*E*> 0; 1>*E*'> 0). By comparison to the previous years (E') there are situations in which there is reverse elasticity (E'<0), explained by the status of the market for milk, fish, meat and their derivates;

- in the case of farmer household elasticity, the correlative form of consumption monetary expenditures (x) and the product consumption (y) the impact forms are also differentiated, according to the product group. In the case of cereals and cereal products, reverse elasticity is maintained (E<0; E'<0), through which the increase in incomes influences a decrease in the consumption of such products. In the case of milk, fish, meat and their derivates, in most years, there is lack of elasticity (1>*E*> 0; 1>*E*'> 0), the consumption of such products is not influenced by the farmer household monetary expenditures.

For all products, though the two types of elasticity (E, E') there is a significant downward trend in the consumption of cereals and cereal products and a balance between expenditures and consumption in the case of milk, fish and meat, manifest in the lack of elasticity.

Conclusions

The differences in terms of expenditures and household food consumption in Romania are the result of a set of factors, among which the reorganisation of the food consumption pattern is the triggering element. From the set of situations presented in this paper, we may synthesise the following:

(1) The consumption dynamics for the main food item reflects, on the one hand, a consumption pattern in which cereals and cereal products are decreased, with a high increase in vegetal fats and fish, and an average increase in the other products. But the consumption levels are differentiates according to the consumers' social groups. The existence of annual consumptions, which record annual growth rates in vegetal fats and especially in animal fats (of +60.0% and respectively of +14.7%), reflects, at the current stage, a need for the consumers below the average incomes (or at subsistence level) who record a stagnation or even a decrease in food purchase possibilities.

(2)The population's overall expenditures structure explains the reason for differentiations in purchasing food. Compared to the overall expenditures, those intended for food purchase record a slight decrease. A significant increase is recorded in the value of agricultural products consumption from own resources, and the same value of expenditures for farmer families indicates a slower rate of decrease. Therefore, in farmer families, food consumption from own resources is still a source of self-supply of about 50%.

(3)The structure of consumption monetary expenditures exhibits annual rates that are differentiated according to the food products destination. For the targeted stage, we emphasise that compared to the overall consumption monetary expenditures, those intended for food purchase record annual decreases, a phenomenon which is manifest at a slower rate in the case of farmer families as well. All these entail substantiations related to, on the one hand, the possibilities to earn incomes that directly influence the expenditures especially on food consumption, and, on the other hand, the changes in food consumption patterns. The differentiation in consumption patterns (traditional/modern and rural/urban) is characterised by access to food which is mainly limited by the household's purchasing power and the population's employment type. It is wirth mentioning that the rural pattern includes those categories of consumers that own terrain and whose food status depends both on their own production and on their purchasing power, determined by the ratio of sold products prices and the prices of products purchased on the market.

(4)In a correlative pattern, the causal knowledge of the expenditure level (x) on food consumption (y), using the elasticity method, illustrates the impact of the expenditures → consumption relationship for the main products. In the general trend of increasing food consumption expenditures, there is a decrease in cereals and cereal products consumption, at a consumption level that does not depend directly on the variation of expenditures on milk, fish and meat. In certain years, for the chain base (the comparison being relative to the previous year), there is a reverse elasticity as well, which explains the actions to improve access to the markets which, for the respective products (milk, fish, meat), were favourable to the consumer.

In order to draw a significant picture of the food consumption status in Romania, it is necessary to now not only the food consumption expenditures, but also the ratio of economic, demographic dependence included in the types and levels reached by the food crisis (quantitative and qualitative ones), indicated for certain social categories of consumers.

References

[1] Alecu,I., - *Agricultural Management in Romania. Past, Present and Future*, Ceres Publishing House, Bucharest, 2002

[2] Alexandri Cecilia, - *Food Safety and Balance in Romania*, GEEA Publishing House, Bucharest, 2001

[3] Brown, L. R., - *Global Issues of Mankind, Treaty, AgroTehnica* Publishing House, Bucharest, 2007

[4] Constantin, M.,- *Agrifood Production Marketing, Treaty,* AgroTehnica Publishing House, Bucharest, 2007

[5] Maliţa, M., ş. a., - *Food Supply and Agriculture in the Next Decades,* Academiei Publishing House, Bucharest, 1979

[6] xxx The Statistical Yearbook of Romania 2005-2010, NIS

STRESS

Alecsandru Ioan BABA[1], Adrian Florin GAL[2]

Abstract. *A critical approach of stress was done based on literature emphasizing on the main aspects of interest. The stress has been appeared with life being a living attribute. Without stress neither the life nor the evolution would exist. This is the stress, good or worse, always present and necessary.*

Key words: stress, stressor, adaptation, emergency

1.Introduction

The expression *stress* appeared together with the introduction in human medicine of biochemical profile. This happened once with the passage from clinician physicians (that often used classical semiological methods to establish diagnosis) to doctors that use numerous preclinical investigations (offered by modern techniques). Nonspecific reactions of every living individual determine researchers to recompose and study the organism in its complexity. There are studies that are interested of the complex relations and interrelations that make the organism to be a perfect cybernetic system.

2.Materials and Methods

The paper is based on the literature in the field and approached in a critical manner various aspects regarding stress along the time. Analysis, synthesis, comparison were the main methods used in order to set up this paper.

3.Results and Discussions

In 1911, Cannon and De La Paz noticed the increase of adrenalin in the blood of a cat frightened by dog. These changes allow some physiological adjustments as a sudden reaction to the specific danger, such as to run or fight. The authors named this physiological stage *emergency reaction*. In 1935, Cannon highlights the existence of some limits regarding the compensation possibilities (in intensity and time) of the body to critical stress [after 1].

---

[1] Prof. Ph.D., Titular member of the Academy of Romanian Scientists, University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, Romania (alecsandru_baba@yahoo.com)
[2] Lecturer Ph.D, University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, Romania (adrianfloringal@yahoo.com)

During 1935-1936, Selye provide a new dimension of this body adaptation phenomenon for changed conditions. The author describe that various excitation determine identical reactions, which was named by the author as general adaptation syndrome [8].

Gradually the study of stress has been provided two directions: investigations regarding physiological response of the stressed organism, and assessments over physiological response. The studies over physiological response focused on adrenal gland reaction, thymic/lymphatic atrophy and acute gastroduodenal ulcer. The physic part has been studied by the way of interpretation of the nervous system to a large variety of environmental events.

The term *stress* entered into biomedical vocabulary relatively fast following its mention by H. Selye (despite the fact of having variable connotations) [8].

The syndrome translated by stereotype response of the organism to various injurious factors was named the *general syndrome of adaptation* (GSA) or *biological syndrome of stress* [8].

Accepting the limits of a classification that might allow the understanding of the complex phenomenon occurring in an organism exposed to stress, there are two main stress factors: (a) stressors that act and generate the reaction of all body (stressors capable to induce GSA) and (b) stressors that act locally and induce local reaction (stressors able to produce *local adaptation syndrome* - LAS). The two factors are interchangeable. In some circumstances and organisms the stressor could trigger GSA, but in some other circumstances the same stressor might determine LSA. The LSA should be considered as a limited reaction of a tissue or organ without involvement of all the body (missing neurohormonal reaction like the GSA). It is considered that LSA might evolve without changing in GSA. In the first stage the body tries to balance using local possibilities. Some local low to moderate intensity reactions or necrosis may occur. These local reactions are often associated with cellular hypertrophy and hyperplasia, and with a local hormonal response produced by *diffuse endocrine system* (DES). DES includes endocrine cells spread in the body having the ability to elaborate polypeptide hormones and biogenic amines. Paracrine phenomenon represents the action of the synthesized hormone on target cell (e.g., serotonin synthesized by DES act on smooth muscle fibers from vascular wall) [6]. Another modality of local action of DES is by distribution of local synthesized hormone to neighboring cells by fine cytoplasm prolongations (direct inoculation in targeted cells) [7].

In this way LSA beneficiate of a complex local response (involving local structures, such as: nervous endings, local vascularization, local cells and DES secretions). It is known that tumor proliferations of DES cells determine over-secretion of active hormone-like products such as: ACTH-like molecules, serotonin, and hormonal polypeptides having neuroendocryne activities.

Over the action of minimal stressors (that have a local action and effect) it is generated the “awareness” of local structures. This is retained in the “tissular memory” that will generate an overreaction to subsequent exposure to stress.

Individual peculiarities have a high impact on the reaction induced by stressor. In similar conditions, the stressor in some people leads to homeostasis equilibration but in some others might determine exhaustion or even shock.

It is hardly accepted how various stressors (cold, heat, transport, pain, joy etc.) might induce identical biological reactions and to generate nonspecific body response. It was proved that nonspecific reactions are common to various stressors. Nonspecific reaction is the first response of the body to stressor. This might be followed by specific reactions. Nonspecific response represents the key-point of all reaction system that receipt and respond immediately. It tries and almost always succeeds to reestablish the homeostasis (using nonspecific reactions that are established without using some specialized structures). If the response (of nonspecific adaptation) is not enough to re-establish homeostasis than other systems might be affected in order to provide an appropriated response. The key-point of the homeostasis equilibrium (by its neuro- and hormonal-regulation) has the property to request selectively the most specialized system capable to react.

Nonspecific response of the body to stressor should be understood as a protection and defense phenomenon of the vital body functions (respiration, cardiac, digestive, nervous activities). The nonspecific reaction runs freely during background vital functions of the body.

The time-evolution of the living beings and their preserving and perpetuation reactions have been selected and improved over time (in order to maintain and perpetuate the life).

Excessive demands determine the involvement of the tools that provide a specific response. Also, some vital functions might be disturbed or deviated. The balance of body functions can’t exceed the innate limits. Deviations of the physiologic records will be always framed in order to allow the maintenance of body functions. The homeostasis is cybernetically regulated and interdependent with all vital body functions in order to survive. Excessive demands induce responses that excess the control leading to the loss of vital functions.

The possibility to assess the body stress (i.e. the certain diagnosis of the adaptation effort during stress) was controversial. The research tried to establish some criteria and to offer methods and efficient tools.

The main criteria used to appreciate the activation degree of adrenal glands [5] are the following: (1) *direct criteria* – plasmatic proportion of ACTH (radioimmunological method); the plasmatic proportion of glucocorticoids (colorimetric, fluorometric and isotopic methods); (2) *indirect criteria* – glycemia, eosinopenia, adrenal glands weight, adrenal cholesterol decline, gastric ulcer.

Indirect criteria rely on hyperglycemia and sanguine changes (leucocytosis with neutrophilia, relative lymphocytopenia and eosinopenia), or variation of the white cells in the milk of lactating cows. The used morphological criteria could be mentioned: the increasement of adrenal glands weight and hypertrophy of the *zona fasciculata*, diminishment of the content of cholesterol and ascorbic acid in adrenal glands. Except the already mentioned aspects there could be mentioned the thymic involution, and diminishment of the Bursa of Fabricius in young animals, diminishment of lymphoid organs (spleen, lymph nodes), and some histological changes of the hypophysis and thyroid.

The first reaction of an animal to stress is by adopting fight or run attitude (i.e. the emergency reaction described by Cannon). The animal may try to counter the potential or imminent danger. When the fight or run response is unsuccessful, the brain initiate the nonspecific response to stress represented by the general syndrome of adaptation.

There were attempts trying to classify the stressors. A suggestive enumeration of stressors includes physical, biological and emotional, ecological, ethological and technological factors.

Dantzer and Mormede (1979) describe three categories of stressors: interactions with other animals (social stress), human-animal interactions (animal manipulation) and interactions between animal and physical environment. As any other classification this do not includes the interference that might occur between these categories that could aggravate the pathological state [5].

The intensive method of animals' growth has been created some stressors. It seems that both animals and humans are not prepared to support without any consequences the passage from biological to technical rhythm (i.e. from natural to artificial environment). Knowing the environment of modern breeders, some authors attract attention over the moral aspect (that is often neglected) and can't justify the attitude of humans over animals [5].

Simultaneous or successive action of some stressors causes pathogenic effects in avalanche. In such situation the stressors determine *over-sensitivity* in the body. There have been observed situations of *over-resistance* that might appear during or immediately after alarm reaction, which manifest during the action of another injurious factor. Body over-sensitivity or over-resistance following exposure to a new stressor proved to be determined by releasement of pituitary and adrenal hormones. Over-sensitivity or over-resistance is related with the exposure period and intensity of the stressor, and with individual peculiarities (age, genetic base, susceptibility of the specie etc).

There are some viruses that remain for a long period into the cell without expressing their presence. Over the action of some factors these viruses become pathogenic. The loss of cell-virus balance could be due to some stressors that trigger a local syndrome of adaptation in the cell. During the non-specific reaction (by local syndrome of adaptation) the cell elaborates metabolites that change the virus status from latent to pathogen. Limited knowledge is known concerning the response of various cell types to stress. This interpretation open new research perspectives; this could elucidate some aspects about the macro-organism – pathogenic agent interrelation. Data convergence proves the necessity to complete physiopathological and etiopathogenic concept of diseases.

The diseases could be classified (depending of the stressor intervention) as follow: diseases produced by the stress; diseases conditioned by stress or stressors; diseases where the stress intervenes as aggravating factor; diseases that are not influenced by the stress.

The understanding of the stress implies a wide view, a modern biological concept adequate for actual knowledge. The stress should be understood as a biological concept, as a property of living, in which some actions over the body trigger a reaction.

The biological concept is a group of interconnected elements that interact. All living systems are open and permanently have exchanges with the environment (e.g., substances, energy and information). The open system has a permanent dynamic balance. The life could be also considered a continuous alternation around an equilibrium point [4]. The most complex cybernetic adjustment is represented by living organism. It has some large possibilities to create regulation boundaries using the feed-back mechanism, thus preserving life. The cybernetic has unimaginable development in our days but the science seems to forget the source of this science that is the body physiology. The literature feels the scarcity of papers studying biological adjustments of the body.

The nervous system has the role to decode information in order to integrate the organism in the environment and to select impulses related with physiological state of the body. The stress belongs to the daily experience of the organism, enriching it with some new reactions to future stimuli. The incapacity of the body to establish informational exchanges and to react is defined as death. By its genetic code each body possess an informational model (some specific structural and functional schemes) which has accounted and codified the experience of previous generations. The life cannot exist without a permanent stimulation but when stressors overwhelm (by number and intensity) the reaction possibilities of the body than the disease is likely to occur.

The stress become pathological when overwhelms the response capacity of the body determining some diseases (i.e. inducing some new connections in the body). The body reacts to some over-demands as such, implying initially the relation functions, nervous system, and endocrine system; afterwards involve the rest of the organs and systems.

The central nervous system (under the stressor actions) has two types of biological adjustments: the mechanism of *run and fight*, conservative hyperemotional reaction, which modify all the energetic potential to *escape* the aggressor; the shock mechanism, a vegetative effort to maintain the threatened homeostasis, mobilizing the potential to re-equilibrate damaged internal functions during aggression. Both mechanisms are compensatory (having a common mechanism) implying catecholamines. Glucocorticoids are the fight hormones and mineralocorticoids are considered restoration hormones [3].

Intensive breeding realized few for animals, always the main target having an economical background. The intensive breeding has been interested by the prevention of infectious diseases. There was a sudden passage to intensive breeding without having adapted animals. If animals raised in large spaces having many possibilities (i.e., opportunity to move and access to the sun in small groups, always in the same shelter, long economical life, a kind caretaker), would be transferred to restrictive spaces (i.e., having a limited possibility of movement, large and permanently changed groups, with successive passages through new technologized spaces - feeding, watering, and an intense economical life) represents permanent technological stressors. These industrial conditions generate stress, the nonspecific injurious factors having a huge involvement in the pathogenesis of several diseases. The animals are raised industrially without having enough knowledge about them. A number of shortcomings (due to ignorance) have been noticed only when animals were merged in large units. The studies involving pathological behavior came to the attention of the researchers when occurred in intensive breeding.

There should be also mentioned that some stressors can trigger all pathogenic diseases. The establishment of pathogenic diseases etiopathogenesis should be clarified. It was confirmed (and still happening) what C. Bernard affirmed: *the microorganism is nothing, the ground is everything*. In various diseases (including cancer) easily they pass over the *ground* where diseases develop. In humans due to memory, stressful mental states can be relived inducing events and reactions similar with the primary stress. Perhaps we deny easily the existence of similar states in animals.

Mechanic D. (sociology physician) and Holmes T. (psychiatrist) realized a hierarchy of the stress as follow: death of a loved person – 100; divorce – 73; prison – 63; accident or disease – 53; retirement – 43; change of the working place – 36; marital hostility – 35; change of professional responsibilities – 29; change of the life style – 26; change of the working schedule – 20; change of the alimentary custom – 15; change of the life environment – 13.

Conclusions

The stress has been appeared with life being a living attribute. Without stress neither the life nor the evolution would exist. This is the stress, good or worse, always present and necessary.

References

[1] Archer, J., Animal under stress, Ed. Arnold, London, 1979

[2]Baba,A.I., Giurgea Rodica, Stresul, adaptare si patologie, Ed.Academiei Romane, Bucuresti, 1993

[3] Chiotan, N., Un concept cibernetic al socului, Ed. Facla, Timisoara, 1981

[4] Constantin, D., Inteligenta materiei, Ed. Militara, Bucuresti, 1981

[5] Dantzer, R., Mormede, P., Le stress en elevage intensif, Masson, Paris, 1979

[6] Delverdier, M., Cabanie, P., Van Haverbeke, G., Rev, Med. Vet., 139, 1, 171, 1988

[7] Leblang, B., Wiers, M., Lagadic, M., Rec. Med. Vet., 157, 629, 1981

[8] Selye, H., Stress in health and disease, Butterworths, Boston, 1976.

MODIFICATION OF THE MAIN PHYSICAL PROPERTIES UNDER THE INFLUENCE OF THE CROP SYSTEM OF THE EROSIONED SOIL IN THE NORTH WESTERN ROMANIA CONDITIONS

Cornel DOMUŢA[1], Maria ŞANDOR[2], Cristian DOMUŢA[2], Ioana BORZA[2], Radu BREJEA[2], Adrian VUŞCAN[2], Aurelia ONEŢ[2], Cristian ONEŢ[2]

Abstract. *The influence of the crop system on the main physical properties of the erosioned soil was studied in the year 2000 in the plots for the erosion measurement placed on the hill with 10% slope in Agricultural Research and Development Station Oradea. The metal panels at the base and soil dams there were between the plots. The variants studied: clean fallow, pasture, wheat, maize on the level curves, and maize from hill to valley. The biggest soil losses were determined in the variant with clean fallow and in variants with maize seeded from hill to valley. The erosion determined the important differences between the physical parameters (hydrostability of the macrostructure – aggregates bigger than 0.25 mm, bulk density, total porosity, hydraulic conductivity, penetration resistance) of the soil in the top of the hill in comparison with the base of the hill. In the top of the hill, the values of the physical parameters were less favorable for plants in comparison with the hill base. The most unfavorable values of the physical properties of the soil were registered in the variant with clean fallow fallowing the variants cropped with maize from hill to valley, the variants cropped with maize on the level curves, wheat and pasture.*

Keywords: soil erosion, structure, bulk density, total porosity, penetration rezistance, hydraulic conductivity

1.Introduction

In Romania and in the North Western part of the country, too, soil erosion affects large area. [1, 2]. The negative influence of the soil erosion on chemical, physical and biological properties of the soil was emphasized by numerous researches from Romania and from the other country [12, 9, 4, 5, 6, 7, 11, 3, 12, 8, 10].

In the Bihor County, an area of 200,000 hectares (38% from the agricultural land) has lands with slopes bigger than 5%, were erosion is possible. The researches

[1] Prof., PhD, Academy of Romanian Scientists Membre, University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048 Oradea, Romania, e-mail: domuta_cornel@yahoo.com,
[2] University of Oradea, Faculty of Environmental Protection, 26 Gen. Magheru St., 410048 Oradea, Romania

regarding the erosion from Bihor County started in 1983 by I. Colibas and I. Mihut, in Hidiselu de Sus, and Pocola and researches regarding the soil management against erosion were made. These researches was continuated by Domuţa C. after 1996 in Pocola. The researches regarding the determination of the soil erosion using the plots for check runn of was made in Beiuş during 1990-1994 and in Oradea after that. Other, researches regarding the soil management on the land with slope was made both in Beiuş and in Oradea [4,5, 6, 7, 14],

2. Materials and methods

The researches were carried out during 2009-2011 in Agricultural Research and Development Station Oradea on a hill with 10% slope. The plots for the soil erosion measurement were placed in the 2000 year, in the following variants: clean fallow, maize from top to valley, maize on the level curve direction, wheat, pasture. The plots' sizes were 45x3.5 m and metal panels were placed at the base of the plots as well as soil dams between the plots on the hill.

The physical and chemical properties of the soil after 9 years of research were determined in a laboratory from the Agricultural Research and Development Station Oradea. The macroaggregates' hydrostability was determined by wet sifting using the Cseratzki method. The bulk density (BD) was determined in 5 repetitions using cylinders with a diameter of 100 cm^3; the same cylinders were used in order to determine the penetration resistance and the hydraulic conductivity of the soil. The total porosity (TP) was calculated using the following formula: TP=(1-BD/D)x100, in which D=density=2.65 g/cm^3. The rainfall data was registered in the Meteorological Station Oradea at $45^o03'$ latitude and $21^o56'$ longitude.

3. Results and Discussions

On the top of the hill, the lowest values of the macro aggregates' hydrostability were registered in the variant with clean fallow. In the other variants studied, the values of the macro aggregates' hydrostability increased; the differences compared with the values in the variant with clean fallow were of 10.0% in the variant with maize cropped from top to valley, 22.2% in the variant with maize cropped on the level curves direction, 31.0% in wheat and 45.1% in pasture. The rows' position from top to valley and the soil erosion between the rows give an explanation for the higher values of the macro aggregates' hydrostability compared to the values registered in the variant with clean fallow from the base of the hill, 56.04% vs. 53.68%; the biggest value of the macro aggregates' hidrostability at the base of the hill was registered in pasture 58.82% (table 1).

Table 1. Macroaggregates' hydrostability modifications under the erosion and crop system influence, Oradea 2011

Crop system	Macroaggregates	Difference		
	%	%	%	%
Top of the hill				
1. Clean fallow	38.30	100	-	-
2. Maize, from top to valley	42.13	110.0	3.83	10.0
3. Maize, on the level curves direction	46.78	122.2	8.48	22.2
4. Wheat	50.14	131.0	11.84	31.0
5. Pasture	55.56	145.1	17.26	45.1
Base of the hill				
1. Clean fallow	53.68	100	-	-
2. Maize, from top to valley	56.04	104.4	2.36	4.4
3. Maize, on the level curves direction	52.40	97.7	-1.28	-2.3
4. Wheat	54.25	101.1	0.57	1.1
5. Pasture	58.82	109.6	5.14	9.6

The influence of the crop system on bulk density

On the soil profile located at the top of the hill, the highest value of the bulk density was determined in the variant with clean fallow, 1.54 g/cm^3. In all of the variants, the values of the bulk density show an improvement of the soil settling with 2.6%, in the variant with maize cropped from top to valley, with 7.8%, distinctively significant, in the variant with maize cropped on the level curves direction, with 10.3% and 14.2%, in the variants with wheat and with pasture (table 2).

The values of the bulk density on the soil profile from the base of the hill are lower than the values in all the studied variants. The highest value was registered in the variant with clean fallow, 1.47 g/cm^3, a very high one. In the variants with maize cropped from top to valley and maize cropped on the level curves direction, the values are high and in the variant with wheat and with pasture the values of the bulk density are median ones. (table 2).

Table 2. Bulk density modifications under the erosion and crop system influence, Oradea 2011

Crop system	Bulk density		Difference	
	g/cm^3	%	g/cm^3	%
Top of the hill				
1. Clean fallow	1.54	100	-	-
2. Maize, from top to valley	1.50	97.4	-0.04	-2.6
3. Maize, on the level curves direction	1.42	92.2	-0.12	-7.8
4. Wheat	1.38	89.7	-0.16	-10.3
5. Pasture	1.32	85.8	-0.22	-14.2
Base of the hill				
1. Clean fallow	1.47	100	-	-
2. Maize, from top to valley	1.43	97.3	-0.04	-2.7
3. Maize, on the level curves direction	1.37	93.2	-0.10	-6.8
4. Wheat	1.30	88.5	-0.17	-11.5
5. Pasture	1.25	85.1	-0.22	-14.9

The influence of the crop system on total porosity

As a consequence, the lowest values of the total porosity were registered in the variant with clean fallow both in the top of the hill (41.8%) and in the base of the hill (44.5%). In the top of the plot, in the variant with maize cropped from top to valley, the value of the total porosity (43.4%) is higher than the value registered in the variant with clean fallow (table 3).

The values of the total porosity at the base of the experimental plots are higher than the values determined in the top of the plots in all of the variants. A better value of the total porosity in comparison with the one determined in the top of the plot in the variant with clean fallow (44.5%) was registered in the variant with maize cropped from top to valley (46%); in the variant with maize cropped on the level curves direction a difference of 48.3% was determined. In the variants with wheat and with pasture, the values determined (50.9% and 52.8%) are higher than the values determined in the variant with clean fallow (table 3).

Table 3. Total porosity modifications under the erosion and crop system influence, Oradea 2011

Crop system	Total porosity		Difference	
	%	%	%	%
Top of the hill				
1. Clean fallow	41.8	100.0	-	-
2. Maize, from top to valley	43.4	103.9	1.6	3.9
3. Maize, on the level curves direction	46.4	106.4	4.6	6.4
4. Wheat	47.9	114.6	6.1	14.6
5. Pasture	50.1	119.9	8.3	19.9
Base of the hill				
1. Clean fallow	44.5	100.0	-	-
2. Maize, from top to valley	46.0	103.4	2.0	3.4
3. Maize, on the level curves direction	48.3	108.6	3.8	8.6
4. Wheat	50.9	114.4	6.4	14.4
5. Pasture	52.8	118.7	8.3	18.7

The influence of the crop system on penetration rezistance

In the top of the hill, the values of the penetration resistance are high in the variant with clean fallow (55.8 kg/cm^2) and in the variant with maize cropped from top to valley (50.1%). In the other variants, the values of the penetration resistance are median ones, 32.7 kg/cm^2 in the variant with wheat and 25.8 kg/cm^2 in the variant with pasture. A difference of 15.2% was registered when comparing the penetration resistance in the variant with maize cropped on the level curves direction with the penetration resistance in the variant with maize cropped from top to valley (table 4).

Lower values of the penetration resistance were registered at the base of the hill than the ones registered at the top of the hill in all of the studied variants. All of the values registered are median, except for the one registered in the variant with pasture, 20.7 kg/cm^2, situated in the median characterization class. In comparison with clean fallow, the differences are lower negative ones (table 4).

Table 4. Penetration resistance modifications under the erosion and crop system influence, Oradea 2011

Crop system	Penetration resistance		Difference	
	kg/cm^2	%	kg/cm^2	%
Top of the hill				
1. Clean fallow	55.8	100.0	-	-
2. Maize, from top to valley	50.1	89.8	-5.7	-10.2
3. Maize, on the level curves direction	38.6	69.2	-17.2	-30.8
4. Wheat	32.7	58.6	-23.1	-41.4
5. Pasture	25.8	46.3	-30.0	-53.7
Base of the hill				
1. Clean fallow	47.0	100.0	-	-
2. Maize, from top to valley	40.1	85.4	6.9	-14.6
3. Maize, on the level curves direction	35.6	75.8	-11.4	-24.2
4. Wheat	25.4	54.1	-21.6	-45.9
5. Pasture	20.7	44.1	-26.3	-55.9

The influence of the crop system on hydraulic conductivity

The hydraulic conductivity had the lowest values in the variant with clean fallow both at the top (1.31 mm/h) and base of the hill (2.37 mm/h); the hydraulic conductivity had a low value in the top of the hill and a median one at the base of the hill. In the variant with maize cropped from top to valley, in the top of the hill, the hydraulic conductivity had a low value, as well, but higher (46.6%), than the value determined in the variant with clean fallow. In the other variants, the differences in comparison with clean fallow are bigger with 155% in the variant with maize cropped on the level curves direction, 206.9% in the variant with wheat and 360.0% in the variant with pasture. There is a difference of 74.0% between the value of the hydraulic conductivity in the variant with maize cropped on the level curves direction and the one in the variant with maize cropped from top to valley (table 5).

Table 5. Hydraulic conductivity modifications under the erosion and crop system influence,Oradea 2011

Crop system	Hydraulic conductivity		Difference	
	mm/h	%	mm/h	%
Top of the hill				
1. Clean fallow	1.31	100.0	-	-
2. Maize, from top to valley	1.92	146.6	0.61	46.6
3. Maize, on the level curves direction	3.34	255.0	2.03	155.0
4. Wheat	4.02	306.9	2.71	206.9
5. Pasture	6.02	460.0	4.71	360.0
Base of the hill				
1. Clean fallow	2.37	100.0	-	-
2. Maize, from top to valley	3.12	131.7	0.37	31.7
3. Maize, on the level curves direction	4.34	183.2	1.97	83.2
4. Wheat	5.06	214.4	2.69	114.4
5. Pasture	7.32	308.9	4.95	208.9

The values of the hydraulic conductivity at the base of the hill in comparison with the values determined at the top of the hill are situated in the same characterization class, median. In comparison with the hydraulic conductivity from the variant with clean fallow, an increase was registered in the variant with maize cropped from top to valley; the differences registered in all other variants were of: -83.7% in the variant with maize cropped on the level curves direction, 114.4% in the variant with wheat and 208.9% in the variant with pasture. There is a difference of 39.1% between the values of the hydraulic conductivity from the variant with maize cropped on the level curves and the variant with maize cropped from top to valley.

Conclusions

(1)The paper based on the researches were carried out in Oradea on a hill with an 10% slope in the plots for soil erosion check and the following variants were studied: clean fallow, maize seeded from top to valley, maize seeded on the level curves direction, wheat and pasture.

(2)The lowest values of the aggregates' hydrostability were registered in the variant with clean fallow both at the top and base of the hill (41.8% and 44.5%); the highest values were registered in the variant with pasture, 50.1% and 52.8%. In the variant with maize cropped on the level curves direction, the macrostructure' hydrostability values are higher than the values from the variant with maize cropped from top to valley.The values of the bulk density, total porosity, penetration resistance and hydraulic conductivity at the top of the hill are worse than the values registered at its base; the biggest difference between the base and top of the hill were registered in the variant with clean fallow and in the variant with maize cropped from top to valley.

(3)The researches results show that the negative effects of the erosion on the land with median slope can be reduced using a good crop structure (pasture, wheat) and working on the level curve.

References

[1] Brejea R., 2009, Tehnologii de protecţie sau refacere a solurilor. Ed Universităţii Oradea, 256-305

[2] Brejea R., 2009, Refacerea şi protecţia terenurilor din carierele de bauxită din Munţii Pădurea Craiului. Ed Universităţii Oradea, 130-145

[3] Budoi Gh., Penescu A., 1996 , Agrotehnica, Editura Ceres, 1996, pag. 427-432.

[4] Domuţa C., 1999, Ameliorarea fertilităţii solurilor erodate pe terenurile în pantă din vestul ţării. Cereale şi plante tehnice nr. 7/1999.

[5] Domuţa C., 2005, Agrotehnica terenurilor în pantă din nord – vestul României. Editura Universităţii din Oradea, 96-117.

[6] Domuţa C., 2006, Agrotehnica diferenţiată. Editura Universităţii din Oradea, 377-442.

[7] Domuţa C., Şandor Maria, Bandici Gh., Sabău N.C., Ioana Borza, M. Cărbunar, Alina Samuel, Alina Stanciu, Ileana Ardelean, Brejea R., Domuţa Cr., 2006, Modifications of the soil structure under the erosion and crops influence in the condition from NorthWestern Romania, Buletin USAMV Cluj-Napoca 63, 447

[8] Doran J.W. et al,1996, Soil health and sustainability Adv Agronomy 56

[9] Eliade Gh., Ghinea L., Ştefanic Gh., 1983, Bazele biologice ale fertilităţii solului. Editura Ceres, pag. 127-130.

[10] Guş P., Lăzureanu A., Săndoiu D., Jităreanu G., Stancu I., 1998, Agrotehnica. Editura Risoprint, 496-499.

[11] Montgomery W.C., 1995, Environmental geology Wm Brown Publisher SUA, 1st Edition

[12] Neamţu T., 1996, Ecologie, eroziune şi agrotehnică antierozională. Ed. Ceres Bucureşti, 17-28; 127-155

[13] Pintilie C., Romoşan Şt., Pop L., Timariu Gh., Sebok P., Guş P., 1980, Agrotehnică şi tehnică experimentală E.D.P. Bucureşti

[14] Samuel A.D., Drăgan – Bularda M., Domuţa C., 2006, The effect of green manure on enzymatic activities in a brown luvic soil. Studia Universitas Babeş – Bolyai, Biologia, L I, 83-93.

Annals of the Academy of Romanian Scientists
Online Edition Series on Agriculture, Silviculture and Veterinary Medicine Sciences
ISSN 2344 – 2085 Volume 1, Number 2/2012

THE EFFECTIVENESS OF FERTILIZERS ON NUTRIENT BALANCE IN TERMS OF SOIL DEGRADATION IN REPUBLIC OF MOLDOVA

Tamara LEAH[1], Serafim ANDRIES[2]

Abstract. *The paper presents the research results on the application of fertilizers in the agriculture of Moldova during 1961-2010. In the recent years the average doses of applied fertilizers were 25 kg/ha. About 90-95% of the total quantities constitute nitrogen fertilizers. The soil nutrients balance is negative, as a result yields are small and low quality. During the period of the 1991-2012 yrs the nutrients deficiency for each hectare was annually: 59 kg N, 14 kg P_2O_5 and 80 kg K_2O. The annual requirement of the total fertilizers for agriculture of Moldova currently consist 240 thousand tones in the active substance. During the last years, the state programs for the remediation of the chemical, physical and biological soil properties, cantering the soil and water protection by the nutrient pollution and substances of plant protection products have been developed that will conduct to remediation of this situation.*

Key words: agriculture, crop, fertilizer, harvest, nutrient balance

1.Introduction

According to the Statistical Yearbook of Moldova on January 1, 2013 the total area of lands was 3.3846 thousand ha, including the agricultural lands – 2.498 thousand ha (73.8%), forest lands – 464 thousand ha (13.7%). From the total area of agricultural lands (farmlands) of 2.498 thousand ha, the arable lands constitute 1.814 thousand ha (72.6%), orchards occupy 135 thousands ha (5.4%), vineyards – 142.6 thousands ha (5.7%) and pastures – 349 thousands ha (14.0%) [1].
The share of farmlands is inadmissible large (73.8%) and for forest is 5.4 times less than optimal ones. The unbalance between natural and anthropogenic ecosystems causes the amplification of the various forms of land degradation.

2.Materials and Methods

The paper is based on the data collected from various sources, mainly from literature in the field and statistical data base in order to characterize the fertilizers effect on nutrient balance in terms of soil degradation.
Analysis, synthesis, comparisons are among he main methods used in this study.

3.Results and Discussions

[1]Associate Prof., PhD, "Nicolae Dimo" Institute of Soil Science, Agrochemistry and Soil Protection, Chisinau, Moldova (tamaraleah09@gmail.com);
[2]Academician of Moldavian Academy of Science, "Nicolae Dimo" Institute of Soil Science, Agrochemistry and Soil Protection, Chisinau, Moldova (ipaps_dimo@mtc.md);

3.1.The natural resources and effectiveness of fertilizer

The territory of the Republic of Moldova is characterized by a rugged relief. Thus, the predominance of the slopes on 80% of the territory creates favorable conditions for the expansion of erosion processes. The average absolute altitude of the surface of the Republic of Moldova is 147 m, the maximum altitude is 429 m, and the minimum one is 5 m. The soil eroded area, which missed from 20 up to 70% of their initial fertility, is about 36% [2].

The climate of the Republic of Moldova is temperate continental, with a mild and short winter (the average temperature of January is -3 ÷ - 5^{0}C) and a warm and long summer (the average temperature of July is 20 ÷ 22^{0}C). In relation to the climatic indices, the territory of Moldova was divided into three areas, which are at the same time and agro-pedoclimatic areas: North, Center and South [3].

The quantity of atmospheric precipitation varies within the limits of 500-630 mm in the North area and 450-500 mm in the South area [4]. The sum of temperatures higher than 10^{0}C constitutes 2750-2850^{0}C in the North zone and 3100-3350^{0}C in the South zone. The hydrothermal coefficient (*K* after Ivanov – Vîsoțchi) is 0.7-0.8 in the North zone and 0.5 -0.6 in the South zone of the country. The frequency of droughts in ten years is: once in the North zone, 2-3 times in the Centre zone and 3-4 times in the South zone.

The soil cover structure is quite complex. The main soil types and subtypes are: chernozems (black earth), occupying 70%; brown and gray soils – 10.2%; alluvial soils – 10.2% and deluvial soils – 4,0% [5,6]. Soils with a high fertility together with the thermal favorable regime allow cultivating a wide range of valuable crops. The current state of soil quality is presented in Table 1.

Table 1. The state of quality of the soil in the Republic of Moldova

The class of creditworthiness note	*Note of creditworthiness, points*	*% from the area of agricultural lands*	*Area, thousands ha*	*Harvest of winter wheat, t/ha*
I	81-100	27	689	3.2-4.0
II	71-80	21	539	2.8-3.2
III	61-70	15	382	2.4-2.8
IV	51-60	15	382	2.0-2.4
V	41-50	9	303	1.6-2.0
VI	21-40	6	153	0.8-1.6
VII	<20	7	178	-
Average	**65**	**100**	**2556**	**2.6**

The soils with the note of creditworthiness 81-100 points occupy approximately 27% of the total area of the agricultural lands [7]. On these soils with a high productivity, presented as a general rule by the typical chernozems and landfill leachate (standard soils) containing organic matter of 3.6-4.5%, can be achieved at the expense of actual fertility 3.2-4.0 t/ha for the winter wheat. The II and III classes with the note of 60-80 points are 36%. The productivity of these soils is also quite high and constitutes 2.4-3.2 t/ha of winter wheat. These classes of soils often are affected by the processes of humification, deficiency in nutrient contents, destructuration and compaction, biological degradation and partial by erosion. The soils of IV, V and VI classes occupy 30% from the total surface and have a note of creditworthiness of 20-60 points and low productivity, 0.8-2.4 t/ha of winter wheat. These soils are affected by variety forms of water erosion and have a very low productivity.

At present the note of creditworthiness is 63 points. The efficient fertility of the soil assures the formation of 2.5 t/ha of winter wheat.

In the conditions of the Republic of Moldova, the soil humidity (rainfall) is one of the main factors determining the formation of high and stable yields. The calculations shown that in a multiannual cycle the average potential harvest of the winter wheat formed from precipitations constitutes 4.3 t/ha.

The difference in yield, obtained in function of the amount of rainfall and the note of creditworthiness is great and constitutes (4.3-2.5 tones) 1.8 t/ha. In the conditions of nutritive elements insufficiencies, the unsatisfactory state of physical and biological characteristics of the soil, plants consume unproductively the humuduty reserves accumulated in the soil for the organic compound synthesis and as a result, harvests are small and low quality.

Those were confirmed by the research carried out in field experiences of long periods of time. It was established that for fertilized variants optimally, the crop plants consumed 20-25% less water compared to the non-fertilized variant [8].

Analyzing the main forms of soil degradation (total 11 forms) was arranged under number 1 - the humus degradation and under number 2 – the agrochemical degradation, the reduction of nutritive elements in soil [9, 10]. These forms of soil degradation occur continuously for all farmlands.

The results of the multiannual field experiences have shown that in the conditions of the Republic of Moldova the use of fertilizers in the optimal doses provide a harvest enhance of 66% for sugar beet, 48% for the winter wheat and 35% for the cultivation of maize for grain and sunflower (Figure 1).

In the Republic of Moldova the regulatory normative were developed in order to determine the necessary in fertilizers for obtaining the expected crops [11,12].

It was established that the use of the optimal doses of fertilizers gave a raise in the harvest of 1.2 t/ha for the winter wheat, 1.4 t/ha of maize for grains, 13.8 t/ha of sugar beets and 0.5 t/ha for sunflower seeds.

The presented data concluded that soil fertilization and optimization of mineral nutrition of plant is an important factor for obtaining high crops.

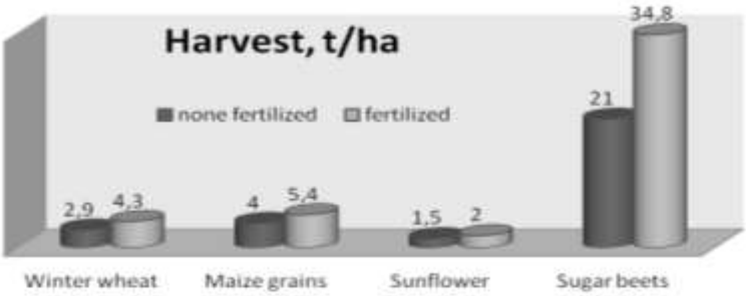

Fig.1. The average harvest of main field crops

3.2.The use of fertilizers and nutrients balance in the soil

Moldovan soils are characterized with a high fertility [13]. The research carried out in the 1950-1960 yrs. demonstrated that the chernozems of Moldova contained in that period 340 t/ha of humus in the 100 cm layer. In the composition of organic matter was contained 20 t/ha of nitrogen and 5 t/ha of phosphorus. The total quantity of P_20_5 in the arable layer was about 160-180 mg and into the depth of 90-100 cm – up to 100 mg in 100 g of soil. The reserve of the total phosphorus in the 1 m of layer was 17 t/ha. Moldovan soils are rich in minerals containing potassium. The total content of these soils is 10-15%. The reserve of the total potassium in the layer of 1 m of chernozems constitutes 170-290 t/ha [14].

In the period 1950-1960 the plant crop harvests were modest and constituted: 1.6 t/ha of winter wheat, 2.8 t/ha of maize, 1.5 t/ha of sunflower and 11.9 t/ha of sugar beets (Figure 2-5).

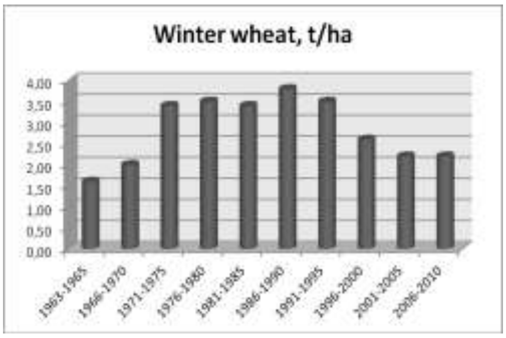

Fig. 2 The dynamics of winter wheat crops

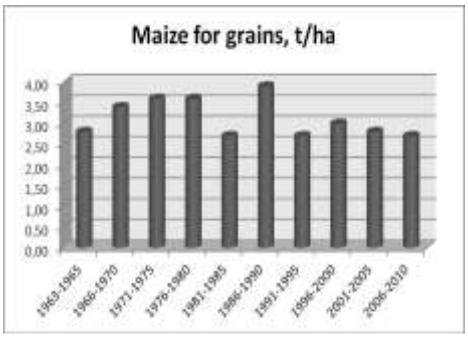

Fig.3. The dynamics of maize crops

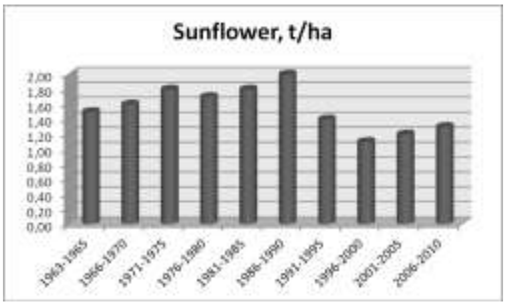

Fig. 4. The dynamics of sunflower crops

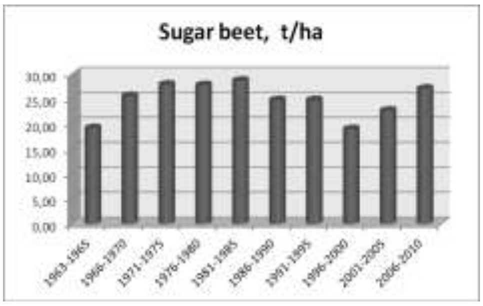

Fig.5. The dynamics of sugar beet crops

Obtaining the high crops was limited by two natural factors: the insufficiency of moisture and the low level of nutrients in the soil. The possible harvests calculated according to the degree of humidity were by 60-70% higher than those obtained of that time (Table 2).

Table 2. Field crop harvests forecast in function of the degree of water supply, t/ha [8]

Crop plants	*Water consumption for obtaining 1 tone of production, tones*	*Soil humidity reserves (by zones), t/ha*		
		North	Center	South
		4010	3620	2920
		Harvest, t/ha		
Winter wheat	820	4.9	4.4	3.6
Maize for grains	640	6.3	5.6	4.7
Sunflower	1330	3.0	2.7	2.2

These data allowed presuming that of limitative factors the first place belonged to the insufficiency of nutrients in the soil. Generally, the effectiveness of fertilizers [E] is expressed by the equation:

$$E = Rws - Rn, \quad where$$

Rws – the quantity of harvest is limited by the extent of water supply;
Rn – the quantity of harvest is determined by the contents of nutrients in the soil.

By the 1965 year, the input of fertilizers in the agriculture of Moldova was insignificant. According to the statistic data, in the period of 1961-1965 yrs. on the 1 ha of arable land and perennial plantations were introduced with mineral fertilizers: 6.2 kg/ha of N, 8.7 kg/ha of P_2O_5 and 3 kg/ha of K_2O. The average dose of organic fertilizers was 1.3 t/ha (Table 3).

The export of nutrients from the soil by crops was significant. As a result, in the agriculture of Moldova was formed a deeply deficient of nutrients. During the considered period the deficit of nutrients per hectare was annually: 59 kg of N, 14 kg of P_20_5 and 80 kg of K_20 (Table 4).

Table 3. Dynamics of the use of mineral and organic fertilizers in the agriculture of Moldova, t/ha

Years	*Mineral fertilizers*						*Organic fertilizers t/ha*	*Total fertilizers applied on the arable and perennial plantations*		
	thousand tons (in active substances)			*applied on the arable and perennial plantations*						
	N	P_20_5	K_20	N	P_20_5	K_20		N	P_20_5	K_20
1961-1965	13.0	19.0	8.0	6.2	8.7	3.6	1.3	12.7	12.0	11.4
1966-1970	33.8	34.2	15.4	15.7	15.8	7.2	1.4	22.7	19.3	15.6
1971-1975	75.6	56.0	34.2	35.4	26.2	15.9	2.9	49.9	33.4	33.4
1976-1980	99.6	84.2	59.8	46.6	39.4	27.9	4.1	66.1	50.4	52.5
1981-1985	148.2	102.4	111.4	70.4	48.6	53.0	6.6	101.4	65.1	92.6
1986-1990	76.0	61.0	50.0	36.5	29.3	24.0	3.0	52.0	37.0	42.0
1991-1995	38.0	28.2	13.3	18.8	13.1	6.1	1.8	28.0	17.5	17.2
1996-2000	8.0	0.3	0.1	3.6	0.14	0.04	0.06	4.2	0.4	0.9
2001-2005	13.6	0.6	0.2	4.6	0.3	0.1	0.02	6.5	0.32	0.3
2006-2010	16.1	1.9	1.0	17.5	2.1	0.9	0.02	18.5	2.7	2.0

Table 4. Balance of nitrogen, phosphorus and potassium in the Moldovan soils, kg/ha [8, 20]

Years	*N*	*P_20_5*	*K_20*	*Sum of NPK*
1913	-22	-13	-52	-92
1940	-26	-15	-62	-99
1945	-15	-15	-52	-82
1950	-27	-13	-68	-108
1951-1955	-27	-12	-62	-102
1956-1960	-40	-14	-82	-136
1961-1965	-59	-14	-80	-132
1966-1970	-36	-9	-84	-130
1971-1975	-22	-1	-79	-103
1976-1980	-15	+11	-66	-69
1981-1985	+9	+22	-33	-4
1986-1990	-15	+25	-49	-8
1991-1995	-18	-11	-80	-113
1996-2000	-30	-21	-83	-134
2001-2005	-24	-23	-81	-128
2005-2010	-26	-22	-84	-132

The research carried out in the 1955-1970 years showed that fertilizers were effective for all the cultures and soils. That was conditioned by the accelerate rhythms of the agriculture chimization. The volume of mineral fertilizers applied to the arable lands and the perennial plantations grew rapidly. In 1970 the agrarian sector of the Republic of Moldova received fertilizers by 2.5 times more in comparison with the 1963 year. The dose of used fertilizers accounted for 62.7 kg/ha NPK. As a result, the balance of nutrients was rapidly improved [15, 16].

In the period of 1981-1988 years for the first time in the history of Moldova's agriculture the nutrient balance became positive.

During this period per hectare of the arable lands and plantations of fruits, with mineral and organic fertilizers, 100 kg N, 66 kg P_2O_5 and 87 kg K_2O were

applied. The average dose of manure applied in the agriculture was 6.0-6.6 t/ha. As a result the productivity of crop plants increased significantly. The average harvest of the winter wheat amounted to 3.8 t/ha, of the maize for grains was 2.4 t/ha and for sunflower was 2.0 t/ha. During the period of chimization, which lasted 25 years (1965-1990) were applied 1200 kg of nitrogen, 960 kg of phosphorus and 860 kg of potassium. The accumulation of nutrients in the soil was relatively small in comparison with their export throughout the entire history of agriculture. Just for 100 years on each arable land with the harvest there were exported 2300 kg of nitrogen, 1000 kg phosphorus, 5000 kg of potassium [16,17].
After the 1998 year, the volume of fertilizers increased substantially, reaching the minimum level in the period of 1996-2005 years. During that period, there were applied about 4-6 kg of nitrogen, 0.3-0.4 kg of phosphorus and 0.3-0.9 kg of potassium per hectare. The nutrient balance again became negative, of minus 30 kg of nitrogen, 21 kg of phosphorus and 83 kg of potassium. As a result, the productivity of crop plants dropped to the level of the 60 years of the last century.
In the recent years (2006-2012) the volume of mineral fertilizers has increased in comparison with the 1996-2006, but it has not been touched even the 1961-1965 years. Currently the fertilizers with nitrogen are preponderantly applied. Practically, the fertilizers with phosphorus are not applied - the first necessary element in soils. In the last 10-15 years the dose of the applied manure in Moldova's agriculture constitutes 0.02 t/ha, the optimal rule being about 10 t/ha.
In the recent years (2005-2012) the average norm of fertilizers applied in Moldova's agriculture amounted to 25 kg/ha, from the total dose of fertilizers about 90-95% is nitrogen one [17, 18].
The largest quantities of fertilizers are applied to the production of potatoes, sugar beets and vegetable crops – 193 kg, 70 kg and 52 kg/ha, respectively. The insufficient quantities of NPK fertilizers is applied to the cultivation of winter wheat - 27 kg, maize and sunflower - 7-12 kg/ha (Table 5).

Table 5. Doses of mineral fertilizers applied to the crop plant fertilization

Crop plants	*Dose of NPK, kg/ha*	*Harvest, t/ha*
Potatoes	193	9.5
Sugar beets	70	27.0
Vegetables	52	9.0
Winter wheat	27	2.2
Maize for grains	12	2.7
Sunflower	7	1.2

3.3.The influence of fertilizers on the agrochemical properties of soils

Humus

Organic mater is the fundamental component of soils determines to a great extent its chemical, physical and biological properties. The preservation of crops and biota with the mineral nutrition depends directly on the organic matter in the soil. It has been experimentally determined that increasing the content of humus with 1% gives 0.5 t/ha of the winter wheat [8,15].

Since the 1953 year the research carried out the agrochemical monitoring. At the same time the balance of humus in the soils has been calculated. It was established that before the period of the intensive chimization (1965-1990) the humus balance was negative (Table 6).

Table 6. The evolution of the humus balance in arable soils, kg/ha [15]

Years	Organic fertilizers applied, t/ha	Balance of humus	
		without erosion losses	with erosion losses
1971-1975	2.9	500	-900
1976-1980	3.9	400	-800
1981-1985	6.0	100	-500
1986-1990	5.6	100	-500
1991-1995	2.6	400	-800
1996-2000	0.1	700	-1100
2001-2005	0.1	700	-1100
2006-2010	0.01	700	-1100

Annually 500 kg/ha of organic matter is mineralized. The systematic use of fertilizers, including 5-7 t/ha of manure, the cultivation of perennial grasses on about 10% of the arable land (180-210 thousand ha) contributed to the formation during the 1975-1990 years to a slightly deficient balance of humus in soils of about minus 100 kg/ha [8].

Over the past 10-15 years the insufficient quantities of manure (0.01-0.6 t/ha) has been incorporated into the soil. The balance of organic matter is negative, minus 700 kg/ha, while with the losses by erosion is of -1100 kg/ha.

The nitrification capacity

According to the Agrochemical Research Service [15] approximately 39% of farmlands are characterized with a low content of organic matter (less than 2%), 40% with moderate (2-4% of humus) and only 20% with the humus content higher than 3.0% (Table 7).

On agricultural lands with the humus content of less than 2% by the nitrification processes in the soil only 50-60 kg/ha of nitrogen is accumulated and the soils with 3.0-4.5% of organic matter – up to 75-110 kg/ha of the mineral nitrogen. These quantities of the mineral nitrogen are sufficient for the formation of 1.7-2.0 t/ha and 2.5-3.7 t/ha respectively of the winter wheat [8, 17].

At present the content of organic matter in the soils of Moldova is about 3.0%. As a result of the mineralization of organic matter, the soils produce annually about 70 kg/ha of nitrogen. This quantity of nitrogen is sufficient for the formation of 2.4 t/ha of the winter wheat.

Table 7. Agrochemical characteristics of the lands of Moldova [15]

Years of the agrochemical mapping	*Contents, % of research area*		
	low	moderate	high
Humus			
1986-1990	41	39	20
Nitrification capacity			
1986-1990	77	17	6
Mobile phosphorus			
1971-1975	68	21	11
1980-1985	50	27	23
1986-1990	31	34	35
Exchangeable potassium			
1971-1975	0	13	87
1986-1990	0	5	95

Phosphorus

Phosphorus has a special role in the metabolism of plants and in the formation of the elevated harvest. Chernozems as well as the gray soils are characterized by the low content of phosphorus in soil [8, 13]. The intensity of phosphate regime has been confirmed by the research results carried out by the State Agrochemical Service [15]. In the 1971-1975 years the surface of soils with low phosphorus content was quite large and constituted approximately 68% [8].

In the period of 1965-1990 years about 960 kg/ha of phosphorus was incorporated into the soils [18]. This agrochemical measure influences beneficially on the phosphorus regime of soils. To the 1990 year the surface of soils with low phosphorus content decreased by 2.0 times, while that with a high phosphorus content increased by 3.0 times. On average per republic the mobile phosphorus content in the soil increased by 2.0 times, as a result the productivity of crop plants has been increased.

In the recent years (2000-2012) in Moldova's agriculture insufficient quantities of P_2O_5 (up to 1 kg/ha) were applied. The export of phosphorus with the harvest is high and constitutes annually about 25-30 kg/ha. The balance of this nutrient element is negative. Currently the post action with phosphorus fertilizers is practically exhausted. With the natural low background of the mobile phosphorus in soil it is possible to get about 2.5 t/ha of the winter wheat. This level of harvest, usually, has been obtained within the country in recent years.

Potassium

The crops for the high harvest formation extract from the soil significant quantities of potassium - 100-200 kg/ha. The soils of Moldova are rich in the total potassium. But the main reserve of available potassium for the plants constitutes the exchangeable form. It was found experimentally that the potassium content for 15-20 mg/100 g of soil is sufficient for the optimal growth and development of plants. According to data only 13% of the farmlands are characterized with a moderate content (10-20 mg) of exchangeable potassium; 87-95% of the total area – with a high content [8,15].

The systematic use of fertilizers in the 1965-2000 years provided an equilibrated balance of potassium in soil. Therefore, the quantity of exchangeable potassium increased average by 2 mg/100 g of soil. The potassium and organic fertilizers are applied in very small doses; the balance of the K_2O in soil is negative.

The soils of Moldova are rich in accessible potassium to plants, but these reserves in a quite long period (150-200 years) may be exhausted. Hence, it is necessary to maintain an optimal regime of potassium already present in the soil by applying fertilizers.

3.4.The requirement of mineral fertilizers in the Republic of Moldova

In the conditions of Moldova the natural factors which limit the production of high harvests are the insufficiency of nutrients in the soils as well the moisture deficit. In order to achieve the growth rate in harvest of 40-50% it is necessary to compensate the deficit of nutrients by the use of fertilizers and rational utilization of the soil moisture [7,17].

In determining the amount in fertilizers for agriculture of Moldova, were used the decisions of the Government of the Republic of Moldova, of the Ministry of Agriculture and Food Industry on the development of the various branches of agriculture by the year 2020, the statistical data for the recent years, the recommendations and norms concerning the application of fertilizers, typical crop rotations models of pedoclimatic zones of the Republic of Moldova have been used. The optimal level of fertilization provides the increase of the fertility of soils, obtaining high crops and a maximum profit from a unit of agricultural land, the protection of the environment from the pollution by nutrients [17].

The optimal application of fertilizers is required for a level of the modern agriculture soil no-till with respecting zonal crop rotations, the soil no-till, the integrated protection of plants, extension of irrigation, the development of the livestock sector, the implementation of intensive technologies of plant cultivation. This system is based on the combined application of organic and mineral fertilizers in couple with fuller use of the biologic nitrogen.

The norms of fertilizer vary depending on the crop from 50 kg/ha NPK for peas up to 225 kg/ha NPK for sugar beets. According to the Programme [7] the average annual dose of fertilizers on the crop rotation of the agro-pedoclimatic zones constitutes:

- North – 5 t/ha manure and $N_{61}P_{50}K_{20}$;
- Center – 4 t/ha manure and $N_{54}P_{45}K_{18}$;
- South – 4 t/ha manure and $N_{47}P_{43}K_{18}$.

Table 8. The optimum doses of mineral fertilizers for the fertilization of the main crop plants, kg/ha of the active substance

Crop plants	*Recommended dose*			*Remark*
	N	P_2O_5	K_2O	
Winter wheat	80	60	40	annual
Winter barley	34	60	0	*
Spring barley	34	60	0	*
Maize for grains	60	50	0	*
Peas for grains	30	20	0	*
Sugar beet	105	80	40	*
Sunflower	45	40	40	*
Tobacco	35	40	40	*
Potatoes	60	60	60	*
Vegetables	90	60	60	*
Maize for silage	40	40	0	*
Fruitful vineyards	60	60	60	once in 3 years
Fruitful orchards	60	60	60	once in 3 years
New vineyards (founding)	-	400	400	to the founding
New orchards (founding)	-	400	400	to the founding

The implementation of the crop rotation with the optimum share of leguminous will allow the accumulation in soil of 30-35 kg/ha per year by the biological nitrogen fixation. The systematic application of fertilizers and organic minerals in doses of $P_{55\text{-}60}$ will allow forming into a multiannual cycle a positive balance and an optimal level of phosphorus in the soil for obtaining high crops. The average dosage of K_{19} fertilizers will be insufficient for the stabilization of potassium in soil. The compensation of the potassium loss will be covered by the local fertilizers and the application of the secondary production as organic fertilizer. The nitrogen deficit will be compensated by the biologic nitrogen (30-35 kg/ha), manure (25-30 kg/ha) and mineral fertilizers (50-60 kg/ha). The share of nitrogen from mineral fertilizers will constitute about 50% of the total content.

Table 9. The annual mineral fertilizer requirements for the optimal crop fertilization, thousand tons of the active substance

Branch, crop plants	*Nitrogen, N*	*Phosphorus, P_2O_5*	*Potassium, K_2O*
Crop rotation	82.3	69.9	28.4
Vegetables and potatoes	6.8	9.0	6.8
Fruitful vineyards	1.5	1.5	1.5

Fruitful orchards	2.0	2.0	2.0
New vineyards	0	2.1	2.1
New orchards	0	1.0	1.0
In addition to irrigated lands	6.3	4.6	3.1
Other crop plants	1.0	1.0	1.0
Total for Moldova	**99.9**	**91.1**	**45.9**

The optimal demand for nitrogenous fertilizers for the crop rotation will be 82.3 thousand tons of the active substance or N_{55} on average per 1 ha (Table 9).

For potatoes and vegetable crops will be needed 6.8 thousand tons of nitrogen with the average dose for 1 ha - N_{60}. For the fruitful orchard fertilization will be needed 2.0 thousand tons of nitrogen, for the fruitful vineyards 1.5 thousand tons. The phosphoric fertilizer requirements will constitute 69.9 thousands tons for the field crops, 9.0 thousand tons for vegetables and potatoes, 1.5 thousand tons – for fruitful vineyards, 1.2 thousand tons for the fruitful orchards. The annual requirement of potassium fertilizers will be 28.3 thousand tons for field crops, 6.8 thousand tons for vegetables and potatoes and 3.1 thousand tons supplementary for the irrigated lands.

The total annual demand of fertilizers for the agriculture of the Republic of Moldova after 2020 will constitute 236.7 thousand tons of the active substance, including 99.9 t of nitrogen, 91.0 thousand t of phosphorus and 45.8 thousand t of potassium. This level of fertilization was reached in the 1976-1985 years by applying annually 243.6-362.0 thousand tons [7].

The use of the optimal fertilization system coupled with other technological links of cultivation of the crop plants will allow to get 4.0-4.2 tons of the winter wheat, 3.6 tons of grain maize and will form an equilibrated nutrient balance in Moldova's agriculture.

Conclusions

(1)For the conservation and enhancement of soil fertility was developed a complex of fitotechnical, agrotechnical and agrochemical measures, which include [7,19]:

- optimization of crop rotation and their implementation in the pedoclimatic zone;
- increasing the quota of perennial grasses (alfalfa, sainfoin) in field cropping up to 10-12%;
- increasing the quota of annual legume crops (peas, beans, soya) in field cropping up to 10-20%. These changes in the structure of the crop rotation will allow to accumulate annually about 40-50 thousand tons of nitrogen or 30-35 kg/ha;
- annual incorporation into the soil of 5-6 t/ha of manure; total of 9-10 million tons;
- application of 100 thousand tons of nitrogen and 90 thousand tons of phosphorus; total of 190 thousand tons;

- minimizing in the admissible limits of about 5 t/ha of the soil erosion.

(2)Over the past few years the State Programs have been developed in order to remedy the chemical, physical and biological characteristics of the soil as well as for the protection of soil and water by the pollution with nutrients and substances of plant protection, including:

- The complex Program of valorification of the degraded lands and improvement of the soil fertility:

Part I. Soil improvement approved by the Decision No. 636 of the Government of the Republic of Moldova from 26 May 2003;

Part II. The improvement of the soil fertility approved by the Decision No. 841 of the Government of the Republic of Moldova from 26 July 2003;

- The Program of conservation and enhancement the soil fertility for 2011-2020 years, approved by the Decision No. 626 of the Government of the Republic of Moldova from 20 August 2011.

These documents determine goals, actions (measures), performance indices, the terms of implementation and those responsible for implementation.

Acknowledgments

This evaluation was supported by the project „Sharing collectively the competences of the researchers to the farmers for a sustainable and ecological exploitation of the agricultural and environment protection (ECO-AGRI)” of the Joint Operational Programme „Black Sea Basin 2007-2013” .

References

[1] Statistical Yearbook of the Republic of Moldova (Tipografia Centrala, Chișinău. 2013), pp.210-216.

[2] Land Cadastre of the Republic of Moldova (Tipografia Centrala, Chișinău. 2009), p. 985.

[3] Lase G. A. Climate of the Moldavian SS Republic (Nauka, Leningrad, 1978), p. 378.

[4] Agroclimatic resources of Moldavian SSR (Gidrometeoizdat, Leningrad, 1982), p. 198.

[5] Krupenikov I.A., Podymov B.P. Classification and the systematic list of the soil of Moldova. (Știința, Chisinau, 1987), p.157.

[6] Soils of Moldova. V.3. (Știința, Chisinau, 1986), p. 336.

[7] Complex Program of valorification of degraded lands and improvement of the soil fertility. Part I. Improvement of soils (Pontos, Chișinău, 2004), p. 212.

[8] Andrieș S. Optimization of soil nutritive regimes and the productivity of crop plants (Pontos, Chișinău, 2007), p. 374.

[9] Krupenikov I.A. Chernozems: ccurrence, perfection, tragedy of degradation, ways of protection and revival (Pontos, Chișinău, 2008), p. 285.

[10] Krupenikov I.A. Chernozems of Moldova (Cartea Moldovenească, Chișinău, 1967), p. 427.

[11] Normatives on the use of mineral and organic fertilizers in the agriculture of Moldava (Pontos , Chișinău, 2000). 112 p.

[12] Andries S., Lungu V., et al. Recommendations for the application of fertilizers on different types and subtypes of soil for the field crops (Chisinău, Pontos, 2012), p. 68.

[13] Ursu A. Soils of Moldova (Stiinta, Chișinău, 2011), p 321.

[14] The complex Program of valorification of the degraded lands and improvement of the soil fertility. Part II. The improvement of the soil fertility (Pontos, Chișinău, 2004), p. 212.

[15] Burlacu I. Agrochemical preservation of the agriculture in the Republic of Moldova (Pontos, Chişinău, 2000), p. 228.

[16] Zagorcea C. The evolution of the circuit and balance the biofile elements in agrofitochenozes from the Republic of Moldova over the last century. Land and water resources. Superior valorification and their protection. V.2. (Pontos, Chisinău. 1989), pp.121-125.

[17] Monitoring of soil quality: bank data, forecasts, conclusions, recommendations (Pontos, Chisinău, 2010), p. 475.

[18] Bulletin of ecopedological monitoring. Agrochemistry. The VII Edition (Pontos, Chisinău, 2000), p. 67.

[19] Programme for the conservation and improvement of soil fertility for the years 2011-2020, approved by decision of the Government of the Republic of Moldova No. 626 from 20 August 2011 (Published: 26.08.2011 in the Official Gazette. 139-145 Article No.: 696).

RESEARCH ON THE PROTEIN CONTENT OF SOME VEGETABLES, DRIED, MODIFIED AND NON-GENETICALLY MODIFIED IN THE CONTEXT OF A HEALTHY DIET

Valentin NECULA, Gheorghe PUCHIANU, D.V.ENACHE

Abstract. *The study highlights the variation in the protein content of different dried legumes, modified and non-genetically modified. The percentage of protein in dry grain legumes is an important factor in determining the need for protein consumed by people belonging to age groups and different physiological condition in the context of a healthy balanced diet. Working as a template we used different varieties of non- genetically modified beans and soybeans genetically modified and non- genetically modified. Variations were observed in the percentage of protein in both varieties of beans, dried genetically modified and unmodified. Variations in the protein have been reported between groups belonging to different soybean and bean varieties. Knowing that grain legumes contain second-class vegetable protein, protein percentage change is also a certainty for genetically modified varieties, thereby affecting the quality of vegetable protein and food quality using this type of protein.*

Key words: dry grain legumes, percentage of protein, genetically modified varieties

1. Introduction

The importance of grain legumes consists,first of all, in the high protein content of the seeds, giving them a high food value.

Plant growing plants included in this group are: peas (Pisum sativum), beans (Phaseolus vulgaris), soybean (Glycine max), lentil (Lens culinaris), chickpeas (Cicer arietinum), tick beans (Vicia faba), lupine (Lupinus sp), widening (Lathyrus sativus), peanuts (Arachis hypogea) and cowpeas (Vigna sinensis).'s all part of the Leguminosales order (Fabales), Leguminosae family (Fabaceae or Papilionaceae family).

The protein content of grain legumes exceeds 2-4 times that of cereals. Some of them (soy, lupine) protein content exceeds the carbohydrate.

[1] Transilvania University of Brasov - Faculty of Food and Tourism
E-mail: validoctoru@yahoo.com, gpuchianu@yahoo.com

The ratio between crude protein and non-proteinaceous components is: soya and lupine 1/1, 7, to, peas 1/2,8, the bean 1/2, 4, etc.. So the grains of the legumes represent aliments and provenders concentrated in protein. It is also noteworthy the high protein value of grain, equivalent to some species with the animal protein, - containing essential amino acids. Grain legume protein has a high digestibility (90%) and it does not form uric acids (as some animal protein) whose accumulation in the body is harmful.

Grain legumes are the main source of vegetable protein necessary for the maintenance of life, growth and for the development of the body and one of the main sources for obtaining animal production.

For example, soya's specific protein is glicinina characterized by high solubility in water (61-92%) and high digestibility as well as the high content of essential amino acids, which results in a nutritional value similar to that of animal protein.

In this context, however, appears the quality problem of the consumed protein and especially thorny issue of genetically modified organisms wich, by recent studies determined the genetic modifications in human populations that consume them.

2. Materials and Methods

This study was deployed on a matrix represented by 8 groups belonging to different varieties of legumes as the following:

Lot 1 - consisting of 6 samples of the variety Borloti beans

Lot 2 - consisting of 6 samples of the variety Flageolet beans

Lot 3 - consists of 6 stages of chick peas.

Lot 4 - consisting of 6 samples of tiny lentils Castellucio variety of Norcia

Lot 5 - consisting of 6 samples of broken peas, beans the variety Bunetto

Lot 6 - includes 6 samples of large green lentils, beans, the variety Noah

Lot 7 - made up of 6 samples of soy non-genetically modified seeds. (Control group)

Lot 8 - made up of 6 samples of soybeans, genetically modified seeds.

Protein determination was performed by distillation by steam stripping, Kyeldahl and the tests to determine the sequences of nucleic acid and the changed or unchanged genetic structure of the analysed soybean varieties was performed by PCR.

The P.C.R. method principle is to identify the variety of Roundup Ready soybean (RRS) is made by detecting a segment of 172 bp, representing the junction region between the CaMV 35S promoter and the CTP4 sequence (Chloroplast Transit Peptides) derived from Petunia hybrida.

Kyeldahl method is based on the mineralization of the sample with sulfuric acid in the presence of catalyst, the total nitrogen in the sample is released in the form of ammonia. Ammonia with sulfuric acid form ammonium sulfate wich is decaying with a strong base (sodium hydroxide) and distilled. The distillate is captured in a solution of H2SO4 and titrated with NaOH. The nitrogen resulted is converted by factor, in protein, using the formula:

$$Proteină\ \% = \frac{0{,}0014(V_1 \times f_1 - V_2 \times f_2) \times F}{m} \times 100$$

in which:

0.0014 - amount of nitrogen in g corresponding to 1 ml of 0,1 N H_2SO_4;
V1 - volume of 0.1 N H_2SO_4 solution used in the capture of the distillate in ml;
V2 - volume of 0.1N NaOH solution used for sample titration in ml;
f1 - factor solution 0.1 N H_2SO_4 solution, (is a constant value equal to 1)
f 2 - factor of 0.1 N NaOH solution, (is a constant value equal to 1)
m - mass of the sample taken in the work, g;
F - total nitrogen conversion factor protein substances;
P -% crude protein

$$P\% = \frac{V_1 - V_2 \times 0,00875 \times 100}{m} = \frac{V_1 - V_2 \times 0,875}{m}$$

3. Results and Discussions

For each analyzed batch were done 6 determinations made by two analysts, taking into account the average of the results of the measurements of the two analysts and not more than 0.5% between two measurements. We present in Table 1, the results of the determined protein in the matrix that included dried, organically grown grain legumes.

Table 1. Determined protein in the matrix that included dierd, organically grown grain legumes

GRAIN LEGUMES SPECIES	AVERAGE PERCENTAGE OF PROTEIN
Beans, variety, Borlotti	24,7
White beans, variety, flageolet	21,2
Chickpeas	17,41
Lentils petty variety, Castellucio of Norcia	25,51
Crushed peas, variety, Bunetto	21,43
Green Lentils great variety, Noah	24,18

Percentage variation between different species of legume protein is highlighted in terms of Fig. 1.

For the determination of soy protein we used a blank represented by a non-genetically modified soybeans (lot7) attested by laboratory tests and PCR samples analyzed genetically modified (lot 8).Mean of two determinations 6 analysts for protein in the control group of non- genetically modified soybeans was 32.4%.

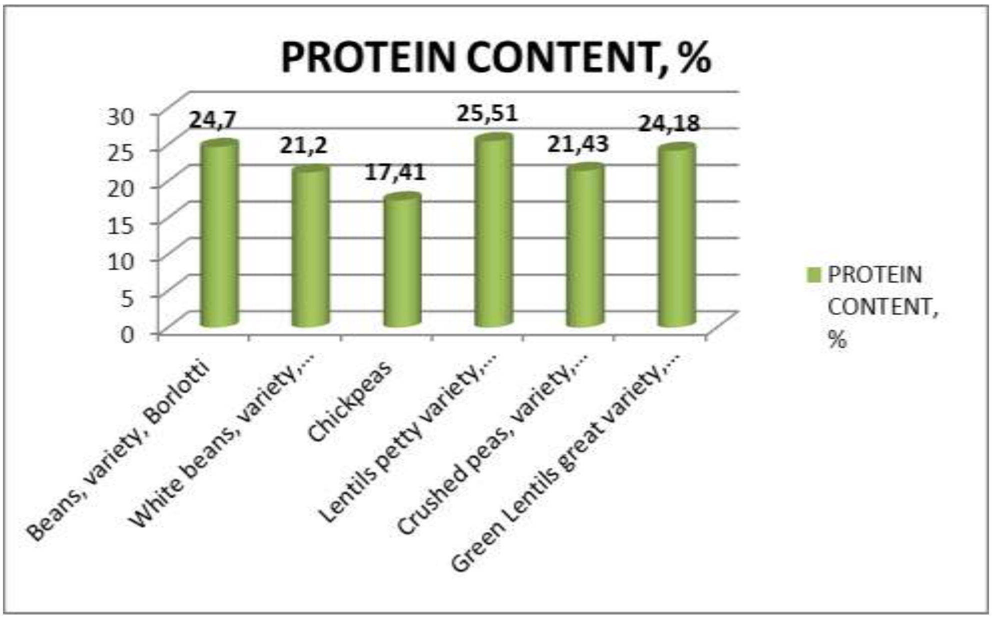

Fig.1. Protein content by legume (%)

The results obtained for the determination of protein made from two analysts for the six samples of soybeans genetically modified to the same conditions are given in table 2.

Table 2. Percentage of determined protein by sample (%)

SOYBEAN SAMPLES ANALYZED	PERCENTAGE OF PROTEIN DETERMINED
Non-genetically modified blank (batch 7)	**32,4**
sample 1 genetically modified	36,45
sample 2 genetically modified	35,18
sample 3 genetically modified	35,20
sample 4 genetically modified	36,18
sample 5 genetically modified	43,43
sample 6 genetically modified	34,80

The change in the percentage of protein in samples of lot 8 genetically modified highlights form Fig. 2.

From the analisys of Fig.2 and Table 2 we can observe increased variation rates of the protein content for the genetically modified samples of soybean. Limits of variability of protein differences from batch 8 are quite large, covering a power range between 0.02% and 8.53%.

In comparison with non-genetically modified blank, represented by the average of the 6 samples belonging to group 7, which is of 32.4% differences for the 6 samples genetically modified Kjeldahl method has the following values of the protein that we present in Table 3.

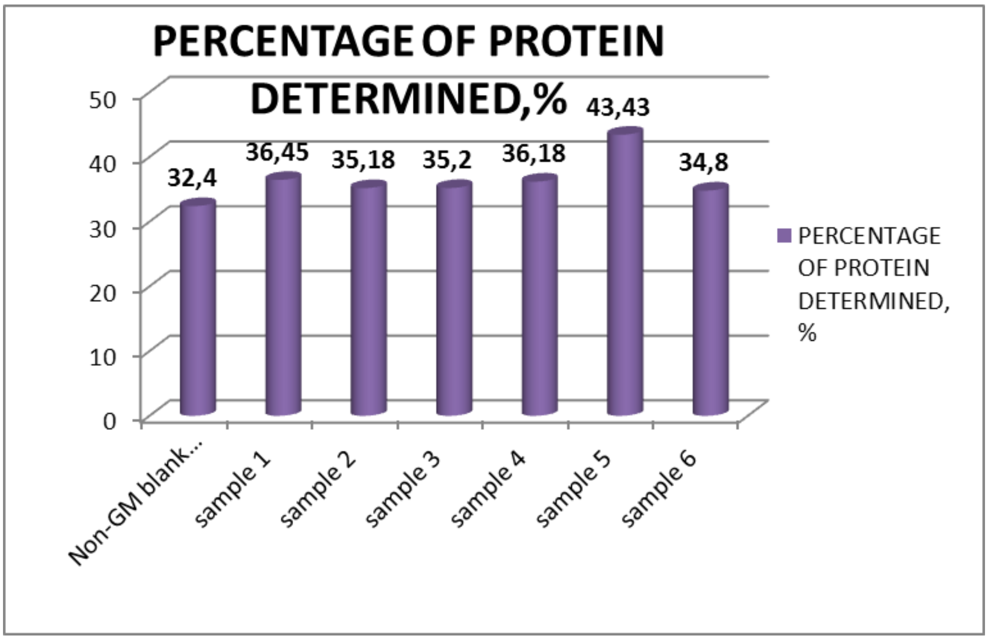

Fig.2. Percentage of determined protein (%)

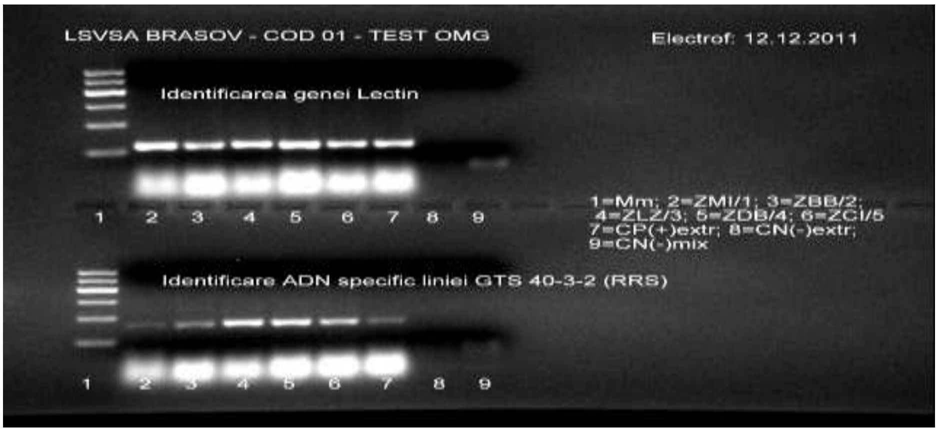

Fig. 3. Molecular blank for the P.C.R. test

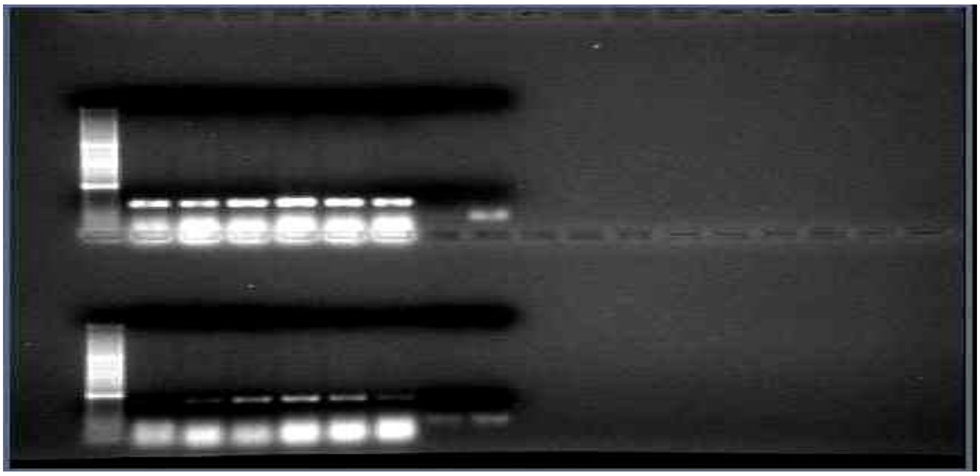

Fig. 4. PCR positive aspect., For sample 1 of genetically modified soy

Table 3. Comparison between Protein values

% PROTEIN IN BLANK SAMPLE (THE AVERAGE VALUE)	% PROTEIN IN GENETICALLY MODIFIED SAMPLES	% PROTEIN DIFFERENCE, RESULT
32,4	36,45	4,05
	35,18	2,78
	35,20	2,80
	36,18	3,78
	43,43	11.03
	34,80	2,40

Table 4. Percentage differences between the referential standard protein and protein values determined by analysis of genetically modified soybeans.

% PROTEIN IN ACCORDANCE WITH THE ORDER 249/2003	% PROTEIN IN GENETICALLY MODIFIED SAMPLES	% PROTEIN DIFFERENCE, RESULT
33	36,45	3,45
	35,18	2,18
	35,20	2,20
	36,18	3,18
	43,43	10,43
	34,80	1,80

Considering represented referential order 249/2003, which specifies the protein content of soybeans, 33% in this case a change occurs, related to an increase in the percentage of protein in genetically modified soybean. Analysing the blank sample in wich the parameter value determined the percentage of protein, 32.4% is observed from the data analysis it matches the value entered in order (33%).In Table 4 we present these value differences.

It is observed in this case a rather high variability limit values covering a range between a minimum of 1.80% protein accounted for sample 6 and a maximum of 10.34 that is assigned sample number 5 of Lot 8. Analyzing all cases of inter-comparisons of the values represented by the percentage of protein derived from genetically modified sample analysis, between them, the differences resulting from the comparative analysis of the control of genetically modified samples or differences resulting from comparing the date of referencing standard samples analyzed, we observe significant differences cover a value between 1.80 and 11.03% protein, in favor of genetically modified soybean varieties.

Conclusions

(1) A healthy diet is based on risk-free and eating genetically modified food.

(2)Genetically modified organisms can fix ,for a specified time period, some problems that the food in our days face.

(3)The effects on the consumer's body are possible and they manifest trough a series of organic disorders from tumors to some defects that appeared at newborn babies.

(4)The PCR method so as the determination of protein by the Kjeldahl method represent high precision laboratory methods covered by RENAR accreditation.

(5)Among the species of dried legumes beans, there are significant differences in the percentage of protein.

(6)The same differences in the percentage of protein is observed in genetically modified soy samples by the examination of several samples.

(7)There are several criteria for inter-comparing between the working matrix elements,between genetically modified soybean samples regarding the maximum and minimum values determined, between the blank and genetically modified soybean samples and between referential approved genetically modified law and evidence.

(8)In all these cases there is a value range which has the maximum and minimum limits.

(9)In the case of the differences in the protein values , their lower values, however, are more compact with less scope for expansion, for example, from 2.20 to 2.18 - 3.18.

(10) There are situations where these limits have huge variations for example 10.43 to 1.80 and 11.03 to 2.40
(11)The increase of the protein percentage in soybeans is a clear indication that the plant is genetically modified but this is a track that can cause the specialist to seek the PCR test detecting any changes, achieving in this way a feedback.
(12)Although the percentage of genetically modified soybean protein is higher, ensuring easier the protein requirement for a consumer during the day, at least for now the following question remains valid: how healthy and without risk to food safety is a such protein?

References

[12] Bădărău, C., L., Marculescu, A., 2008, Food Biochemistry, Vol I Transilvania University Publishing House, Brasov.

[13] Bădărău, C., L., Marculescu, A., 2009, Food Biochemistry, Vol II, Transilvania University Publishing House , Brasov.

[14] Bîlteanu Gh, Crop, vol I, 1998, Cereals and legumes, Second Edition, Ceres Publishing House, Bucharest.

[15] Drăgulin, C., Stefanescu, A., 1998, General Commodities Publishing Mirton Timişoara.

[16] Gont, I.,Man's rational nutrition, 1971, Didactic and Teaching activities, Bucharest .

[17] Laşcu, D., 2008, Food Encyclopedia Publishing All.

[18] Pîrşan, P., 1998, Legumes, Mirton Publishing House, Timişoara.

[19] Radulescu, E., 2003, Smart Food, Life and Health Publishing House, Bucharest.

[20] Gh.V. Roman, et al., 2006, Crop - Cereals and legumes, Ceres Publishing House, Bucharest.

V.Necula, M. Babii, 2010, Food, food and their impact on consumer's health, Transilvania University Publishing House, Brasov.

RESEARCH ON ROMANIA'S OIL SEEDS BIODIESEL PRODUCTION POTENTIAL

Agatha POPESCU[1]

Abstract. *Romania has a high potential for producing biodiesel from rape, sunflower and soybean seeds. In the period 2006-2010, Romania cultivated 1,296 thousand ha in average, per year, with these oil crops and produced 6,748.5 thousand tons solid biomass, of which 44 % from sunflower, 20 % from rape and 36 % from soybean. Energy production estimate/year, based on seeds biomass, was 110,518.58 GJ, of which 54.2 % from sunflower, 20.5 % from rape and 25.2 % from soy bean. Annual biodiesel production was estimated at 277,631.5 thousand liters, of which 63.5 % from rape biomass, 33.5 % from sunflower biomass and 2.9 % from soybean biomass. In conclusion, Romania is able to reach its target of 20 % biofuel blend with classic fuels by the year 2020 according to the EU provisions.*

Key words: biodiesel, biomass, oil crops, Romania, energetic efficiency

1. Introduction

"Biofuels represent substitutes for petrol and diesel and promptly available on a large scale for ordinary vehicles"(EU Renewable Energy Directive 2009/28/EC).
Their use had the advantage to emit less than 35-40 % green house gases than the fossil fuel, with a positive impact on environment sustainability and to diminish fuel import decreasing the degree of energy dependence of a country.
The main biofuels are bioethanol and biodiesel. Despite that biofuels have advantages, the big disadvantages are related to land and food diversion to fuel and in addition increased pollution of the air and soil (Pimentel *et al*, 2005). Biodiesel is poorer in Carbon than diesel (-8.98 %) and Hydrogen (-0.79%), but it contains 10 % Oxygen, stimulating the burning process in the engine (Burnete *et al.*, 2011).
For this reason, biofuels are used in some proportions with the classic fuels without imposing a change of the engines. Sunflower biodiesel but also rape and soy bean seeds, in general oilseed crops could offer an alternative to fossil diesel (Madyira *et al*, 2012).
Because biofuel could be produced of cereals, oil crops and other resources, one of the main aspects which has to be taken into consideration is the cultivated area

[1] Prof.Ph.D., University of Agricultural Sciences and Veterinary Medicine of Bucharest, Romania, (e_mail: agatha_popescu@yahoo.com)

with energetic crops and biomass production which should not affect the amount needed to cover human food and animal feedstuff consumption.

Biodiesel production depends on crop type, cultivar, cropping technology, plat protection measures (Adamiak *et al*, 2009), cultivated area, biomass production/ha (Adamovics *et al*, 2009), conversion efficiency into biofuel given by output/input ratio (Rathke *et al*, 2009).

Economic aspects regarding oil seed production, oil extraction, biodiesel processing have also o be taken into account (Jaeger *et al*, 2008).

Biodiesel represents 75 % of biofuels produced in Europe. The EU is the top producing area with a market share of 65 % in the world biodiesel production (Biofuel production.www.biofuelstp.eu/fuel production.html).

The EU is focused on the security of energy supply based mainly on biodiesel production. Till 2020, the EU member states have to carry out at least 10 % share of renewable energy in the total transport consumption of essence and diesel (Biofuels. Agriculture and Rural Development, www.ec.europa.eu/agriculture).

As an EU member state since 2007, Romania became a REFEP member in 2008, aligning its legislation and measures to the EU Regulations to stimulate biofuel production, mainly biodiesel in order to reach its target of 10 % biofuels in 2020, estimated at 514 thousand tep (thousand tons of oil equivalent), while gasoline will account for 5,139 thousand tep (EuroStat, 2011).

This will contribute to the sustainable development and less energy import. During the period 2006-2010, the energetic consumption decreased by 12 %, accounting for 34,817 thousand tep in 2010, of which 78.77% was assured by domestic primary energy production and the difference of 21.23 % by import. However, the increased biofuel production had diminished import by 37 %, assuring 78.8 % energetic independence of the country (Romania's Statistical Yearbook, 2011).

Biofuels could be obtained by biomass conversion into energy as long as at world level it s a huge variety and amount of resources for producing biomass (Green Media, 2006, Biomass-Precious energy and heat source).

In Europe, biodiesel is the mainly produced from sunflower and rape seeds In the EU, 84 % biodiesel is produced from rape oil, 13 % from sunflower oil and 3 % of soy bean oil.

In Romania, there are some research results, mainly during the last decade, regarding biofuel production reflecting the production capacity in the energy sector (Burnete *et al*, 2011, Chintoanu *et al*, 2008, Oancea, E., 2010, Popescu Agatha, 2010).

In this context, the paper aimed to estimate Romania's annula energy potential in terms of solid biomass production and biodiesel production, taking into consideration cultivated area and production of oil crops, energy content by crop and biomass conversion rate into biodiesel. The analysis was carried out for the period 2006-2010 and was based on the data provided by Romania's Statistical Yearbook, 2011.

2. Materials and Methods

In order to set up this paper and estimate Romania's potential for producing biodiesel, the following indicators were used: biomass production estimate, energy production estimate from total biomass provided by oil crops, biodiesel production estimate and cake and glycerin byproducts production estimate.

In this purpose, the following data were collected from Romania's Statistical Yearbook, 2011: arable land, cultivated area, total area cultivated with oil crops, cultivated area for sunflower, rape and soybean, seed yield/ha by crop, seed production by crop, for the period 2006-2010.
In the study, it was calculated the average for each indicator mentioned above for the period of fie years.
The calculations were based on the following formulas:

Biomass production estimate:

$$BQ_T = \sum_{i=1}^{n} (Q_i + q_i) = \sum_{i=1}^{n} (Q_i + Q_i * \alpha_i) = \sum_{i=1}^{n} Q_i\,(1 + \alpha_i),\ \text{where:}$$

Q_T = total biomass production, Q_i= main biomass production for i energetic crop= seed production, i=1,2,3…,n energetic crops; q_i = secondary biomass production for i energetical crop= specific secondary production for each crop; α_i= conversion coefficient of main production into secondary production for the i energetic crop.
The values considered for α_i were the following ones:1.65 for sunflower, 1.5 for rape and 2 for soy bean based on the main production/secondary production ratio (Balteanu, G, 2005).
Energy production estimate:

$$EPE_T = \sum_{i=1}^{n} (E_i + e_i) = \sum_{i=1}^{n} (Q_i * \beta_i) + (q_i * b_i) = \sum_{i=1}^{n} Q_i\,(\beta_i + \alpha_i * b_i),\ \text{where:}$$

E_T=total energy production from solid biomass coming from oil crops; E_i=energy production resulted from main biomass production for i oil crop, where i=1,2,3,...,n; e_i= energy production resulted from secondary biomass production for i oil crop; β_i= energy content in terms of GJ/ton in the main biomass for i oil

crop; b_i= energy content in terms of GJ/ton in the secondary biomass for i oil crop.
In the calculus, β_i and b_i had the following values: for sunflower: β_i= 24 GJ/ton and b_i=17.85 GJ/ton; for rape: β_i= 23 GJ/ton and b_i=12.5 GJ/ton; for soybean: β_i= 16.6 GJ/ton and b_i=9 GJ/ton (Oancea, E., 2010).

Biodiesel production estimate:

$BDE= (Q_i - Q_i * \% C)* CC$, where:

BD= biodisel production; Q_i= main biomass production (seeds); % C = percentage of seeds destined to human and animal consumption; CC= concersion coeffient of solid biomass into biodiesel.
In the calculus, only the main biomass production (seeds) was taken into account, of which the following percentage was considered available to be transformed into biodiesel: 90 % of rape main biomass, 20 % of sunflower main biomass and 6 % of soy bean main biomass (Oancea, E., 2010).
Aso, it wsa taken into consideration biodiesel rate of oil seeds, as follows: 17 % (0.170) for soy bean biomass, 41.5 % (0,415) for sun flower and 36 % (0.360) for rape (Oancea, E., 2010).

Cake production estimation:

$CPET= \sum_{i=1}^{n} (Q_i * \beta_i * \gamma_i)$, where: CPET= cake production; γ_i= cake rate of

processed main biomass (seeds) into biodiesel. The ocnsidered value for γ_i was the following one: 58.4 % for sun flower seeds, 60 % for rape seeds and 82.5 % for soy bean seeds.

Glycerine production estimation:

$GPE= (\sum_{i=1}^{n} Q_i)* \delta$, where: GPE= glycerine production estimate; δ=glycerin

rate from seed production destined to produce biodiesel. The δ value taken into consideration was 42 kg/ton seeds.

3.Results and Discussions

Romania is among the largest countries in Europe coming on the 7^{th} position I the EU with 283,391 square km surface. It has a huge potential for crop production

with 9,405 thousand ha arable area, representing 64.26 % of agricultural land, 14,635.5 thousand ha (Statistical Yearbook, EuroStat, 2011).
Due to its favorable soil and climate conditions and geographical position in the Central-Eastern Europe, its long tradition in crop and animal farming, it has a high potential for producing biomass both of vegetal and animal origin.
The capacity for producing biomass varies from a region to another. The plains could provide about 9-12 t/ha/year, while the mountains and the hilly areas mainly from the Southern Romania could produce 14-18 t/ha/year. In the Eastern part of the country, more precisely in Dobrudja, in te North –Eastern Romania and along the Danube River, the biomass production is lower, just 4-8 t/ha/year. A high biomass potential is in Tulcea area, accounting for 30-40 t/ha/year. The highest biomass amount is offered by the plains situated in the Southern, Western and North Eastern Romania.
The main resource of agricultural biomass of vegetal origin is represented by cereals: wheat and maize, which could be used for producing bioethanol and oil plants such as: sunflower, rape and soy bean for producing biodiesel.
At present, Romania produces only biodiesel as the EU is mainly focused on this biofuel production (EuroStat, 2011).
The cultivated area recorded a slight decline from 7,884 thousand ha in 2006 to 7,807.4 thousand ha in 2010. Its share in the arable land represented 83.01 % in 2010 and 83.14 % in 2006, reflecting that there is still about 17 % uncultivated arable land, representing about 1,598 thousand ha (Table 1).

Table 1. Arable and cultivated area, Romania, 2006-2010 (thousand ha)

Year	Agricultural land	Arable land	Cultivated area	Share of cultivated area in the arable land (%)
2006	14,731.0	9,434.6	7,884.0	83.56
2007	14,709.3	9,423.3	7,777.2	82.53
2008	14,702.3	9,415.1	7,798.1	82.82
2009	14,684.9	9,422.5	7,884.1	83.67
2010	14,635.5	9,405.0	7,807.4	83.01
2010/2006 %	99.35	99.68	99.02	-

Source: Romania's Statistical Yearbook, 2011, Own calculations.

The cultivated area with oil crops accounted for 1,409.7 thousand ha in 2010, being by 8.63 % higher than in the year 2006.
Three oil crops are the most important ones for producing biodiesel: sunflower, rape and soy bean. Their surface accounted for 1,292.3 thousand ha in 2006 with a share of 99.59 % in the oil crops cultivated area and for 1,392 thousand ha in 2010 with a share of 98.74 %.

In 2006, the share of these 3 crops in the oil crops cultivated area was the following one: 76.4 % sunflower, 14.7 % soybean and 8.5 % rape. In 2010, sunflower was cultivated on 56.1 % land, rape on 38.1 % and soy bean on 4.5 % land with oil crops.

Therefore, sunflower remains on the 1st position with 790.8 thousand ha despite that its share decreased in oil crops area. Sunflower is a very important crop for producing oil both for domestic and EU market.

Table 2. Oil crops cultivated area, Romania, 2006-2010 (thousand ha)

Years	Oil crops cultivated area, of which:	Sunflower		Rape		Soy bean	
		Thou ha	%	Thou ha	%	Thou ha	%
2006	1,297.6	991.4	76.4	110.1	8.5	190.8	14.7
2007	1,340.4	835.9	62.4	364.9	27.2	133.2	9.9
2008	1,239.4	813.9	65.7	365.0	29.4	49.9	3.9
2009	1,253.8	766.1	61.1	419.9	33.5	48.8	3.8
2010	1,409.7	790.8	56.1	537.3	38.1	63.9	4.5
2010/2006 %	108.63	79.76	-	488.01	-	33.49	-

Source: Romania's Statistical Yearbook, 2011, Own calculations.

Rape cultivated area increased 4.88 times in 2010 accounting for 537.3 thousand ha due to its high importance in producing biodiesel.

Soy bean cultivated land deeply decreased by 66.5 %, accounting just for 63.9 thousand ha in 2010. This happened because of the prohibition regarding the use of genetic modified soybean imposed by the EU.

The oil seeds average production varied from a crop to another during the peiod 2006-2010. Also, it varied according to climate conditions, mainly the drought of the year 2007 deeply affected production performance per surface unit in case of all the studied crops. The yield calculated as an average during the five year period was 1,743 kg/ha soy bean seeds, 1,507 kg/ha and 1,332 kg/ha sunflower seeds. Sunflower produced 1,597 kg seeds/ha in 201, by 3.70 % more than in 2006. Rape seed yield accounted for 1,755 kg/ha in 2010, being by 10.4 % higher than in 2006. Soy bean yield was 2,345 kg/ha in 2010 by 29.7 % higher than in 2006 (Table 3).

Table 3. Oil seeds yield by crop, Romania, 2006-2010 (kg/ha)

Year	Sunflower seeds yield	Rape seeds yield	Soy bean seeds yield
2006	1,540	1,590	1,807
2007	654	991	1,021
2008	1,437	1,844	1,817
2009	1,433	1,357	1,726
2010	1,597	1,755	2,345
2010/2006 %	103.7	110.4	129.7

Source: Romania's Statistical Yearbook, 2011, Own calculations.

Oil seed production increased by 15.97 % from 2,050.1 thousand tons in 2006 to 2,377.7 thousand tons in 2010. The lowest level, 1,046.6 thousand tons was recorded in 2007, the year with the terrible drought.

In 2006, the share of oil crops in the total oil seed production was the following one: 74.4 % sun flower, 8.5 % rape and 1.6 % soy bean, all these three crops contributing by 99.8 % to oil seed production.

In 2010, their weight in oil seed production was: 53.1 % sun flower, 39.7 % rape and 6.3 % soy bean, all together representing 99.07 % of production. Therefore, the change of the cultivated area and yield had a direct influence on the oil seed total production (Table 4).

Table 4. Oil seed production by crop, Romania, 2006-2010 (thousand tons)

Year	Oil seed production	Sunflower seeds	Rape seeds	Soy bean seeds	Production of the 3 crops
2006	2,050.1	1,526.2	175.1	344.9	2,046.2
2007	1,046.6	546.9	361.5	136.1	1,044.5
2008	1,942.3	1,169.9	673.0	90.6	1,933.5
2009	1,764.0	1,098.0	569.6	84.3	1,751.9
2010	2,377.7	1,262.9	943.0	149.9	2,355.8
2010/2006 %	115.97	82.74	538.5	43.46	11.5.13
Average 2006-2010	1,836.14	1,120.8	544.4	805.8	1,826.4

Source: Romania's Statistical Yearbook, 2011, Own calculations.

Sunflower seeds production decreased by 17.26 % from 1,526.2 thousand tons in 2006 to 1,262.9 thousand tons in 2010, while rape seed production increased 5.38 times from 175.1 thousand ton sin 2006 to 943 thousand tons in 2010. Soy bean seed production registered a deep reduction, accounting for 56.54 % from 344.9 thousand ton sin 2006 to 149.9 thousand tons in 2010.

Estimation of solid biomass production from oil crops. Taking into account the primary and secondary production and the conversion coefficient into biomass for the 3 oil crops, the biomass production was estimated for the minimum, maximum and average seed production in the period 2006-2010.

Romania's biomass production was 6,748.5 thousand tons in average, ranking between a minimum level of 2,139.9 thousand tons and 7,436.6 maximum level.
The average biomass production estimate accounted for 2,970.1 thousand tons for sunflower, 1,361 thousand tons for rape and 2,417.4 thousand tons for soy bean. Based on the minimum and maximum production, the ranking of the crops w as: sunflower, rape and soy bean.
In case of sunflower, the solid biomass production is mainly produced by secondary production (62.26 %) and seed production contributed by 37.74 %. In case of rape, seed production could contribute by 40 % to biomass production and the secondary production by 60 %. In case of soy bean, seeds could contribute by 33.34 % and the secondary production by 66.66 % to the solid biomass production (Table 5).
Energy production estimate from solid biomass produced by oil crops. During the analyzed period, Romania's average energy production was estimate at 11,518.5 thousand GJ, while the minimum potential accounted for 39,460.02 thousand GJ and the maximum potential accounted for 132,883.46 thousand GJ (Table 6).

Table 5. Biomass production estimate for oil crops destined to produce biodiesl, Romania, 2006-2010 (thousand tons)

Oil crop	Specification	Minimum Biomass production	Maximum Biomass production	Average Biomass production
Sunflower	Primary production	546.9	1,526.2	1,120.8
	Secondary production	902.4	2,518.2	1,849.3
	Total biomass production	1,449.3	4,044.4	2,970.1
Rape	Primary production	175.1	943.0	544.4
	Secondary production	262.6	1,414.5	816.6
	Total biomass production	437.7	2,357.5	1,361.0
Soy bean	Primary production	84.3	344.9	805.8
	Secondary production	168.6	689.8	1,611.6
	Total biomass production	252.9	1,034.7	2,417.4
TOTAL SOLID BIOMASS PRODUCTION ESTIMATE		2,139.9	7,436.6	6,748.5

Source : Own calculations

Table 6. Energy production estimate from solid biomass produced by oil crops, Romania, 2006-2010(thousand GJ)

Oil crop	Energy production estimate from:	Minimum energy production	Maximum energy production	Average energy production
Sunflower	Main biomass production	13,125.60	36,628.80	26,899.20
	Secondary biomass production	16,107.84	44,949.87	33,010.00
	Total energy production	29,233.44	81,578.67	59,909.20
Rape	Main biomass production	4,027.30	21,689.00	12,521.20
	Secondary biomass production	3,282.50	17,681.25	10,207.50
	Total energy production	7,309.80	39,370.25	22,728.70
Soy bean	Main biomass production	1,399.38	5,725.34	13,376.28
	Secondary biomass production	1,517.40	6,208.20	14,504.40
	Total energy production	2,916.78	11,933.54	27,880.68
TOTAL ENERGY PRODUCTION ESTIMATE		39,460.02	132,882.46	110,518.58

Source: Own calculations

The contribution of each oil crop to the energy production potential was determined by the amount of solid biomass estimated for the whole plant by crop and the energetic value of each plant in terms of GJ/ton.

The contribution of each oil crop to the total energy production estimated as average for the period 2006-2010 was the following one: sunflower 54.20 %, soy bean 25.24 % and rape 20.56 %.

Table 7. Contribution of each oil crop to energy production estimate from solid biomass, Romania, 2006-2010 (%)

Oil crop	Minimum energy production	Maximum energy production	Average energy production
Sunflower	74.08	61.39	54.20
Rape	18.52	29.62	20.56
Soy bean	7.40	8.99	25.24
Total	100.00	100.00	100.00

Source: Own calculations

Romania's biodiesel production estimate. Substracting the need of seeds for human food and animal feedstuff consumption, it remained 90 % of rape biomass, 20 % of sunflower biomass and 6 % soybean biomass to be used for estimating biodiesel production. Taking into account the seed conversion rate into biodiesel: 41.5 % for sunflower, 36 % for rape and 17 % for soy bean, the biodiesel production estimate in the period 2006-2010 was 277,631.5 thousand liters in average, 437,723.9 thousand liters as maximum performance and 102,975.3 thousand liters as minimum level (Table 8).

Table 8. Biodiesel production estimate/year from biomass produced from oil crops, Romania, 2006-2010 (thousand liters)

Oil crop	Specification	MU	Minimum biodiesel production	Maximum biodiesel production	Average biodiesel production
Sunflower	Biomass production (20% of seed production)	Tons	109,380	305,240	224,160
	Estimated biodiesel production	Thousand liters	45,392.7	126,674.6	93,026.4
Rape	Biomass production (90% of seed production)	Tons	157,590	848,700	489,960
	Estimated biodiesel production	Thousand liters	56,732.4	305,532	176,385.6
Soy bean	Biomass production (6% of seed production)	Tons	5,060	20,690	48,350
	Estimated biodiesel production	Thousand liters	8,602.2	3,517.3	8,219.5
BIODIESEL PRODUCTION ESTIMATE/YEAR		Thousand liters	102,975.3	435,723.9	277,631.5

Source: Own calculations

The contribution of each crop to the average biodiesel production estimate was: 63.53 % from rape, 33.50 % sun flower and 2.97 % soy bean. Therefore, the most suitable oil crops for producing biodiesel in Romania are rape and sunflower, rape contribution to biofuel production being double compared to sunflower contribution.

Table 9. Contribution of oil crops to biodiesel production estimate, Romania, 2006-2010 (%)

Oil crop	Minimum biodiesel production	Maximum biodiesel production	Average biodiesel production
Sunflower	44.08	29.07	33.50
Rape	55.09	70.12	63.53
Soy bean	0.83	0.81	2.97
Total	100.00	100.00	100.00

Source: Own calculations

Cake production resulted from biodiesel production process accounted for 464,774.15 tons/year, while ***glycerin production*** accounted for 32,023.7 thousand tons (Table 10).

Table 10. Cake and Glycerin production estimate, resulting from biodiesel production process, Romania, 2006-2010

Product	Oil crop	MU	Minimum production	Maximum production	Average production
Cake	Sunflower	Tons	63,877.9	178,341.9	130,909.4
	Rape	Tons	8,835.6	509,220	293,976
	Soy bean	Tons	4,174.5	17,069.25	39,888.75
	Total cake	Tons	76,888	704,631.15	464,774.15
Glycerin	Sun flower + rape+ soy bean	Thousand Tons	11,425.2	49,334.5	32,023.5

Source:Own calculations.

Conclusions

(1)Romania has a high potential for producing biofuels in general, but mainly for biodiesel, because of the important surface cultivated with oil crops, the possibility to extend this surface in the uncultivated areas and biomass production potential.
(2)The main crops suitable to produce biodiesel are sunflower, rape and soy bean.
(3)In the period 2006-2010, the average cultivated area with these three crops per year was 1,296.4 thousand ha. In 2010, the share of oil crops in the cultivated area was 56.1 % for sunflower, 38.1 % for rape and 4.5 % for soy bean.
(4)The average seed production per year was 1,332 kg/ha for sunflower, 1,1507 kg/ha for rape and 1,743 kg/ha for soy bean.
(5)Biomass production estimated in average per year was 2,970.1 thousand tons for sunflower, 1,361 thousand tons for rape and 2,417,4 thousand tons for soy bean, totalizing 6,748.5 thousand tons/year.
(6)In average, energy production estimate based on the total solid biomass production estimate, was 110,518.58 thousand GJ, of which 54.20 % from sunflower, 20.56 % from ape and 25.24 % from soy bean.
(7)Biodiesel production was estimated at 277,631.5 thousand liters in average fr the whole studied period. The contribution of the oil crops to biodiesel production estimate was: 63.53 % from rape, 33.50 % from sunflower and 2.97 % from soybean.
(8)From biodiesel production processing, it also resulted 464,774 tons cakes and 32,024 thousand tons glycerin as byproducts.
(9)Based on this analysis, the final conclusion is that Romania is able to reach the target percentage of biofuels grace of its biomass production potential represented by oil seeds and also by other sources.

References

[1] Adamiak, J., Adamiak, E, 2009, The energetic value of winter rape seeds depending on cropping system, protection level and cultivar, Journal Fragmenta Agronomica, 009, vol.27(1):p.7-13

[2] Adamovics, A., Dubrovskis, V., Plume, I, 2009, Agrobiotechnologies and plant biomass production for energy, ESF Project " Attaction of human resources to the research of the renewable energy source", Contract No.2009/0225/IDP/1.1.2009/APIA/VIAA/129

[3] Balteanu, G., 2005, Phytotechnics, Ceres Publishing House, Bucharest.

[4] Burnete, N., Naghiu, A., Varga, B, 2011, Biofuels- necessity of Romania as UE member state, March 8, 2011

[5] Chintoanu, M., Naghiu, A., Naghiri Livia, 2008, Biomass resources for producing bioenergy, Agriculture –Science and Practice, 1-2/2008:112-117

[6] Flach, B., Lieberz, Sabine, Bendt Karin, Dahlbacka Betina, 2011, EU-27 Biofuels Annual Report, www.gain.fas.usda.gov/Recent GAIN Publications/Biofuels Annual-The ague-EU-27-6-22-2011.pdf

[7] Jaeger, W.K., Siegel, R, 2008, Economics of oilseed crops and their biodiesel potential in Oregon's Willamette Valley, Special Report 1081, p.18-30.

[8] Oancea, E., 2010, The management of using crops in order to obtain energy based on solid biomass, Doctoral Thesis, University of Agricultural Sciences and Veterinary Medicine of Bucharest, Romania, p.127

[9] Madyira, D.M., Nkomo, Z., Akinlabi, E.T., 2012, Characterizing sunflower oil biodiesel blends as alternatives to fossil diesel, Proceedings of World Congress Engineering, WCE, May 2012, London, UK, pp.1889-1894

[10] Naghiu, A., Chintoanu, M., Burnete, N., David Adriana, 2008, Considerations on omania's potential for biofuel production an use, cited by Oancea E., 2010, in The management of using crops in order to obtain energy based on solid biomass, Doctoral Thesis, University of Agricultural Sciences and Veterinary Medicine of Bucharest, Romania

[11] Piementel, D., Patzek, T.W., 2005, Ethanol production using corn, switchgrass and wood.Biodiesel production using soybean and sunflower. Natural Resources Research, Vol.14(1), March 2005:65-76

[12] Popescu Agatha, 2010, Considerations on Rape – A crop for Durable Agriculture in Romania of the 3rd Millennium, Annals of Craiova University, Series Agriculture, Montanology, Cadaster, Vol. XL/2/2010, p.529-534

[13] Popescu Agatha, 2012, Research regarding oilseeds crops development in Romania in the EU context, Journal of Agricultural Economics, Ekonomika Poljoprivrede, Vol.1:129-138

[14] Rathke, G.W., Schuster, C., Diepenbrock, W, 2009, Energy recovery of winter oil seed rape (*Brassica Napus* L.). The 10th International Rapeseed Congress, Canberra, Australia, 2009

[15] Biofuel production. www.biofuelstp.eu/fuel production.html

[16] Biofuels. Agriculture and Rural Development, Biofuels, www.ec.europa.eu/agriculture/bioenergy/biofuels

[17] EU Renewable Energy Directive 2009/28/EC,

[18] EUFAS Posts. EuroStat 2006-2009

[19] EuroStat Database, 2011, Biofuel production in the EU.

[20] Green Media,2006, Biomass-Precious energy and heat source

[1] Romania's Statistical Yearbook, 2011, www.insse.ro/Transport

FOOD SAFETY AND STRATEGY- INTERRELATIONSHIPS AND FIELDS OF ACTIVITY INVOLVED

Dan SCHIOPU[1], Agatha POPESCU[2], Anca BELU[3]

Abstract. *The paper aimed to present the actual context of food safety and its strategy. After definining the concept of food safety, the growth of population is presented by world region, as well as food diets, arable land per capita, and requirements regarding agriculture taking into account the increased area of degraded land. Pollution of the environment affects agriculture and its products. The interrelationships resulting from air self purifyingare presented schematically as well as their influence on the harvest quantity and quality, ways to reduce energy consumption and effect on greenhouse effect. Global warming raises new problems, to which agriculture will have toface. Are taken into consideration economic aspects, the risks of a different nature, with some of the measures and ways of prevention.*

Key words: food safety, strategy, global context

1.Introduction

Food safety is defined as "the existence of the conditions required for human population to benefit of an active life and health. It is an objective of agricultural policy both at national and international level, whose purpose is both the development of the agricultural sector, as well as the assurance of producing and purchasing power for food products environmentally clean" [6].
Food safety is similarly defined by FAO, as "the ensurance for each individual at all times in any place or moment, the access to sufficient and healthy food, allowing a satisfactory diet for a healthy and active life."
The both definitions are related also to food quality, meaning to be "ecologically clean" or "diet to be healthy."
According to FAO, food safety is appropriate when a food is tasty and, by consumption, it does not alter and compromise the health status of the organism. It is carried out by engaging all factors and implementation of all standards which supports and ensures the achievement of food products whose nutritional and consumption value are the fundamentals of a healthy diet [6].

[1] Prof.Dr., Academy of Romanian Scientists, 54 Splaiul Independentei, District 5, 050094, Bucharest, Romania, Phone:+40213147491, Email:danschiopu30@yahoo.com
[2] Prof.Ph.D., University of Agricultural Sciences and Veterinary Medicine of Bucharest, Romania, (e_mail: agatha_popescu@yahoo.com)
[3] Ship-building „Damen”, Galati, Romania, Phone:+40236.30.71.58

2.Materials and Methods

The paper is based on the literature in the field being a synthesis of the main ideas concerning food safety and food security starting from the concept and passing to the determinants and related factors of influence.

3.Results and Discussions

Taking into account the limited surface of the earth and the geometrically growth of population it is impossible t assure food for all the people [7] (Fig. 1).
The forecast for the end of the 21 century is 10 billion people, but some new estimates show that it could be reached since 2050 [8].
But, besides the numerical growth one has also to consider the growth of average consumption in terms of calories/man/day: in Eastern Asia, in the years 1961-1963, 1,750 calories/man/day and in the year 2010, 3,040 calories/man/day, while in the developed countries, for the same period of time, it was 3,020 calories/man/day, respectively 3,470 calories/man/day. In average, overall, in 2010, it was assured only 2,860 calories/man/day [3].
These calories could be taken from vegetable products (primary calories) or from animal products (secondary calories).

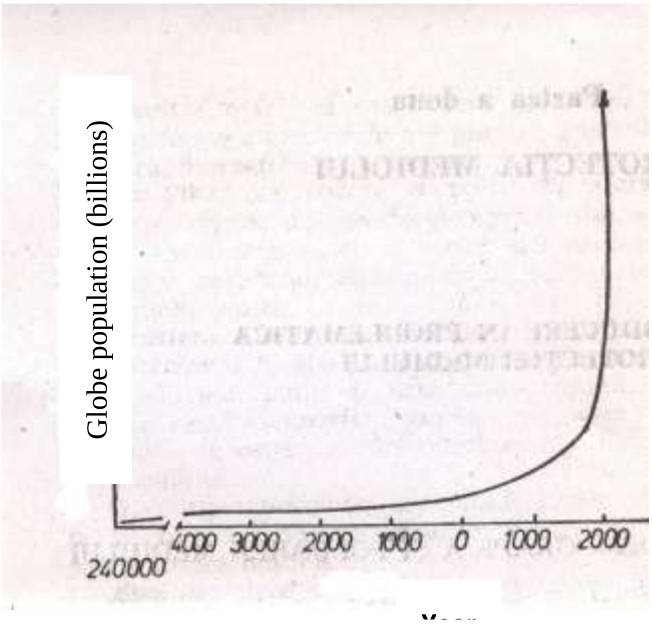

Fig. 1. World population growth (*Şchiopu D.,* 1997)

Proper nutrition requires both products of vegetal origin, as well as animal products: it is compulsory the existance in diet of unsaturated fatty acids, which are found in food of vegetal origin and of the 9 essential amino acids, which are found in animal products: valine, leucine, izoleucine, fenilalanine, thionine, methionine, triptophan, histidine. A daily diet of approximately 3,501 calories/man/day, consisting of 1,790 primary calories and 1,711 secondary calories is equivalent to 13,767 primary calories, because it is considered that a secondary calories is obtained from 7 primary calories [13].

Current animal production technologies allow a higher performance meaning a cheaper meat. Taking into account that food made of meat is tasty and satiety, the consumption of meat has increased, some categories of the population exceeding the norms recommended by nutriţionists.

By increasing the consumption of meat, the surfaces of fodder crops will double [12], resulting a decrease of the areas producing food for human beings.

But, as long as consumption of calories is not uniform on the Earth, it is estimated about 1 billion malnourished people for the years 2010-2011, compared with 800 million in 1995, this category of the population reaching 19 %, compared to 16% as they were in the reference year [8].

In 2009, the statistical data showed that about 17 billion children, meaning one of four, do not benefit of sufficient and healthy food [9].

In Romania, food consumption has increased from 3,020 calories/man/day in 2000, to 3,350 calories/man/day, in the year 2005[4].

The minimum arable land per person varies depending on the origin of food: primary or secondary calories. In case of a severe diet, poor in proteins and animal fats, it could be even 0.09 ha and even less, depending on the technology progress applied in agriculture, especially in hot and humid areas (South-Eastern Asia), where land is cultivated all the time. In 1970, in Japan, arable land per capita accounted for 0.054 ha [11].

In our country, on July 1st, 1978 it was about 0.448 ha arable land per capita and in 2004 it was about less, 0.40 ha arable land per capita [4]. In fact, it was a smaller figure if one take into account the fact that many areas were not and are still not cultivated.

Therefore, there is a series of situations which highlight food safety at present and in the coming future both at world level and in our country as well.

Agriculture is the first called to contribute to ensure food safety by increasing production quality per surface unit. This goal is achieved through a variety of technical measures with different energy ncosumption (Table 1).

But, agricultural area used to produce food will be smaller while its use is changed (due to the development of localities, infrastructure, and sport fields) and by soil degradation.

In California, to Central Valley, that provide almost a quarter of the national vegetable output, the cultivated surfaces are decreasing annually by 6,000 ha, where commercial and residential areas are built. "At national level, each new-born or immigrant means more than half of a hectare of arable land disappeared.

Table 1. Grouping of agro-phytotechnical measures depending on fossil fuel consumption, CO_2 and other greenhouse gases producing on production

Group characteristics	Agro-phytotechnical measures
1. They do not require fossil fuel consumption, not generate CO_2 and other greenhouse gases and contribute to production growth.	Ecological crop maping, territory cadastre, crop rotation, extension of crops improving soil fertility and perennial crops, use of long lasting vegetation period and drought, cold and disease resistant cultivars (when technical and organizational reasons allow this), respecting the optim moment for tillin and quality indices as well as the moment of harvesting etc.
2.They require a very low fuel consumption, and contribute to production growth.	Seed conditioning destined to sowing, hybrid seed producing, pulse and other plant seeds bacterization, utilization of mycorrhizas, manure controled fermentation (including earthworms breeding).
3.They require fuel consumption, generates $CO_{2,}$ they are compulsory and when they are rationally used they contribute to production growth.	Tillage, soil fertilization and amendments, disease, pest and weed control, irrigation, drainage etc.
4.They require a high fuel consumption to create artificial environment conditions, and generate high amount of $CO_{2.}$	Crop production in greenhouses, hydroponic cropping.
5. They do not contribute to production growth (sometimes they produce production losses) and generate $CO_{2.}$	All measures inadequately applied, inclusively field burning when phitosnitary reasons do not impose this.

Source:*Şchiopu D*, 2005

Table 2: The proportion of degraded areas, by region, in the period 1945–1990

Continent	Degraded percentage(%)
Australia	16
Europe	25
North America	26
Asia	38
South America	45
Africa	65
Central America	74

Source: (*M. Berca*, 2005)

For this reason, most of forecasts suggest that, of the additional billion of cereal tons that we will need (that is in the USA) in 2030, four-fifths should come not from additional cultivated hectares, but from the intensification of agriculture, i.e. from obtaining a higher amount of cereals on the already cultivated land. In 2030, it is expected as yields to rise from the present level of 2.4 tons cereals/ha, to 3 tons, according to FAO" [12].

A study made by the United Nations shows that, at the end of the second world war up to the year 1990, the cultivated areas registered a decline, due to degradation of 552 million hectares (38 %). The situation, by region, is shown in Table 2.

Also the soil in our country are exposed to soil, their productive capacity being restricted by large a variety of factors (Tabel 3).

Table 3. The main restraining factors of soil productivity in Romania

Restrains	Area	(thousand hectare)
factors	Agricultural	Arable
Frequent drought	3,900.00	
Periodical excess of soil moisture	900.00	
Soil erosion due to water:	4,065.00	2,100.00
- land sliding	700.00	-
Wind erosion	386.70	-
Excessive skeleton on soil surface	300,00	52.00
Soil saltness	600.00	
Soil compaction to tillage (plowpan)	-	6,500.00
Soil primary compaction (pedogenetically)	-	2,060.00
Crust forming	-	2,300.00
Humus low and very low reserve	7,772.20	4,553.10
High and moderate acidity	2,355.40	1,619.20
High alkalinity	160.80	121.20
Low and very low P_2O_5 assurance	4,477.90	2,877.00
Low K_2O assurance	490.80	250.90
Low N assurance	3,641.70	2,667.30
Microelements deficiency (Zn)	-	1,500.00
Soil destruction by various excavations	15.00	-
Soils covering with wastes and solid residues	18.00	11.20
Soil chemical pollution, of which:	900,00	-
. excessive pollution	200,00	-
. pollution with oil and salted water	50.10	-
. pollution with substances carried by wind	147.30	82.10

Obviously, if the situation will be maintained, food safety is damaged.

Land Law 18 resulted in making about 3.5 million owners, whose land is in average 2.4 – 2.5 ha and this is divided into several plots, a fact which does not allow the application of modern tehnologies. It is about not only to ploughing across contour line, but also to the unable of herbiciding and mechanized harvesting using high productivity machinery. Construction of irrigation systems, protectives forest belts, antierosion constructions etc. require land merging to stop soil degradation in order not to endanger food security for future generations. In other words, food strategy requires measures for soil conservation. Food strategy is required to solve land merging.

In the period 2004-2009, about 2.5 million hectares in some countries (Ghana, Madagascar, Ethiopia, etc.) have been sold to other countries (China, South Korea, the Arab Emirates etc.) seeking to provide to needed agricultural area for feeding their own population. Other target countries are: Australia, Russia, Philippines, Mexico, Brazil, and „investing” countries " are: Bahreim, China, Japan, the Gulf countries, Egypt, India, Kuwait, Libya, Malaysia, Saudi Arabia, South Korea, etc "[8]. Taking into account this aspect, who are the winners and who are the loosers? Which countries will be able to store agricultural products and will orient needed food or to create an artificial food crisis? What category is our country included?

In the law regarding agriculture organization and encouragement from 22 March 1937, surnamed *Şişeşti law*, referring to the transmission of rural agricultural property originating from the state and by state, it is provided that it can be sold only if some conditions are fulfilled, including *that both buyer and seller to be a Romanian citizen* [10].

Environment pollution affects agriculture, therefore, food security, and its companion, food safety. Figure 2 shows the actions of air polluants on agricultural ecosystems Strategies for the prevention of such situations means at the same time strategies for food security.

Petroleum crisis together with pollution produced by fossil fuels stimulates production of biofuels, so that we get back to the previous situation before mechanization, when fodder producing for draft animals generate competition with food producing for people.

In 2008, almost 30% of U.S. maize harvest was used to manufacture ethanol, compared with 10% in 2002 [8].

Among the measures listed in Table 1, there are some risky measures such as: environment pollution due to the process of fertilizer and pesticides manufacturing, but also products pollution with nitrites and pesticide residues, etc,. In animal husbandry, it could appear products pollution with sanitary-veterinary substances, microbial pollution, with parasites or sanitation substances, with livestock manure later used as organic fertilizer, which become sources of pollution for plants producing food or animal feed. Also, uncontrolled food products can contribute to the spread of zoonosis, as well as bovine spongiform encephalopathy (mad cow disease), poultry flue etc. Both vegetal and animal production could pollute surface waters and ground-water.

Therefore, it is a risk to assure food safety. The Authority for Food Safety, Ministry of Environment and Forests, by Environment Guard, Ministry of Agriculture and Rural Development, using the data of Academy for Agricultural and Forest Sciences, Ministry of Health through Public Health Inspection and using data of Public Health Institute, there are some institutions which have to avoid such situations.

Biological, organic and integrated agriculture (multicropping and adaptive management) are involved in producing „organic or green food". A sugestive example is the following one: In 2009, a Japanese introduced ducklings on a land sowed with rice. The ducklings prefered to consume insects and young weeds and not rice, but theyr fertilized the soil with their dejections. Later, in the rice plantation it was introduced a duckweed which housed a seaweed which, in its turn nourished worms, which in their turn were eaten by fishes. And fishes fertilized soil with them manure. Thus, the area has produced at the same time duck and fish meat and also rice. In this way, the plant, which followed rice in crop rotation, found a fertilized land. The story described abouve showed that no pesticides and chemicl fertilizers were used, so that it resulted a reduced consumption of fossil fuels. They should have generated the danger of environment pollution and food as well. Everything has been carried out by increasing agricultural ecosystem biodiversity [12].

During the second world war, the brochures for agricultural propaganda used to recommend the use of mobile coops in order to bring hens to crops for destroying insects.

In our country, it was an aternative to use sheep in order to destroy weeds in a wheat field, because sheep prefer weeds easier to be eaten than wheat.

The use of fossil fuels in upstream of agriculture, directly in the processes of agricultural production, or downstream, contributes to the generation of greenhouse gases, which shall be added to the natural causes of global warming.

Global warming has negative influences on life in general and, consequently in agriculture, which means a series of hazards caused by: increasing the frequence of storms, hurricanes and tornados, hail storm, extreme climate phenomena (alternation of catastrophic flood with droughts in various years like 2006 and 2007 or in the same year like 200, high temperature amplitudes between day and night (the case of the year 2007 particullarly in the Northern part of Romania), late spring-summer or early fall frosts, very low temperatures in winter (which compromise autumn crops) or prolonged drougths and high temperature in autumn, making impossible setting up autumn crops [1].

In addition, the emergence of new diseases and pests, the change of the conditions that determine crop mapping etc have to be added to al these factors mentioned above.

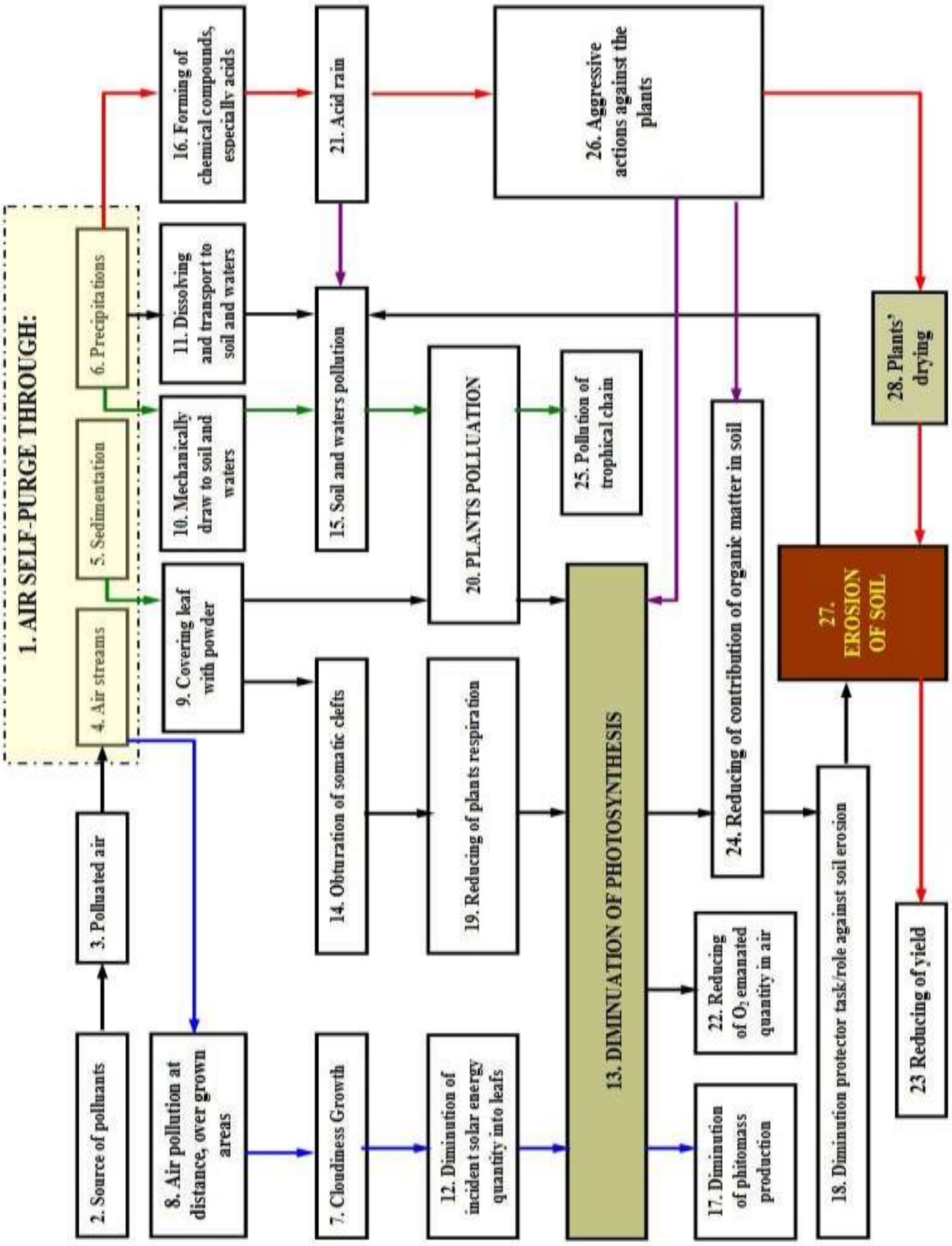

Fig. 2. Phenomena resulting from air self-purge in agricultural ecosystems
Source:*Şchiopu D., Dumitru M.*, 1991

Risks caused by climate conditions could bring damages which are reflected by harvested amount and product quality. In 2007, in Romania, only the grain losses exceeded Euro 500 million, and the losses for sunflower and other summer accountde for over Euro 2 million [1]. Again , food security is affected.
When they have been given the opportunity, the people made food supplies, even thou they had no idea about food security. With the development of society, food preservation procedures have been developing contributing to food trade. Synthetic preservatives have replaced salt (which was too much) and smoke (carcinogenic), synthetic flavors and colorants made food more pleasant. Long distances between the place of production and the place of consumption, as well as products handling have determined prepackaging in vacuum for some products. The limited free time has generated the appearance of pre-prepared food. Food should be attractive for buyer, and from here, a more attactive package was created. All of these have increased food cost, which means for most of buyers, that fodd has become more difficult to access.
The large variety of added substances (preservatives, flavors, synthetic colourings, together with pesticide residues or veterinary medicines pre-existing their industrialization, make them no longer correspond in term of "healthy food", affecting again food safety.
Terrorism could also be fociused on food safety along the product chain: production - storage - processing - marketing, but also in the connected sectors.
We all are consumers of what we find in the market food. Therefore, it is important to know how to conceive our diet (the proportion between hydrocarbonates, fats, proteins and vitamins, minerals etc.), what we would like to buy and eat, to know what to chose from what is offered, to konw how to preserve food. It is necessary to develop a food culture [5].

Conclusions

Consumers have to be consciuos of food safety and security. They have to get knowledge regarding healthy food, which requires training starting from early childhood. This may be done in schools where professors are called to teach the future qualified mid-range and higher level labor force, for all the sectors involved in security and food safety. Is a condition required by food strategy.
The subject is vast and it is not possible to approach all the aspects. The next research works are expected to develop many interesting aspects, which will open new horizonts for people knowledge and practice.

References

[1]Berca M., Gestiunea mediului natural. Editura Ceres, Bucureşti, 2005

[2]Berca M., Probleme ale managementului de risc la nivelul întreprinderilor agricole cauzate de modificările climatice. Agricultorul român, nr. 6, septembrie 2007.

[3]Brunel, S., *Feeding Ten Billion People?*, in The Geopolitics of Hunger 2000-2001, Action Against Hunger, Lynne Rienner Publishers, London, 2001

[4]Buhociu I., Buhociu C. A., Apa şi agricultura în perspectiva dezvoltării omenirii. Revista Cereale şi plante tehnice,nr.9-10, 2009, p.24-25

[5]Constantin, M., Marketingul producției agroalimentare. Editura AgroTehnica, Bucureşti, 2009, p.76.

[6]Dediu, I., Enciclopedie de ecologie. Academia de Ştiințe a Moldovei, Chisinau, I.E.P.Ştiința. Tipografia „SEREBIA", 2010

[7]Malthus, T., An Essay on The Principle of Population, Electronic Scholarly Publishing Project, London, http://www.esp.org/books/malthus/population/malthus.pdf, 1998

[8]Mâşu, Ş., Omenirea secolului al XXI-lea şi guvernul mondial. Chapter "Economic wars in the XXI-st century", p. 308-309.Editura RAO, Bucureşti, 2011

[9]Mihai, C., America, ţara bonurilor de masă. Ziarul Adevărul, 26 august, Bucureşti, 2011

[10]Mureşan, M., Concepția lui Gheorghe Ionescu-Şişeşti privind agricultura. Legea privitoare la Organizarea şi încurajarea agriculturii şi semnificațiile ei actuale. În volumul omagial 125 ani de la naşterea acad. Gheorghe Ionescu-Şişeşti. Editura Academiei Române, 2011

[11]Puia, I., Soran, V., Agroecosistemele si alimentatia omenirii. Ed. Ceres,. Bucuresti, 1981

[12]Robert, P., Sfrârşitul hranei. Pericolul înfometării în era supermarketurilor. Editura Litera Internaţional, Bucureşti, 2009, p.281

[13]Şchiopu, D., Ecologie şi protecția mediului. Editura Didactică şi Pedagogică, Bucureşti. 1997, p.83

[14]Şchiopu, D., Agricultura şi efectul de seră. Probleme de agrofitotehnie teoretică şi aplicată, vol. XXVII. Nr. 1. Institutul de Cercetare-Dezvoltare Agricolă, Fundulea, 2005

RESEARCH ON SOME MICROBIOLOGICAL QUALITY OF NATURAL SPICES USED IN THE FOOD

Gheorghe PUCHIANU[1], V.NECULA, Mihaela BABII, D.V. ENACHE

Abstract. *During the period 1.01.2012 - 30.04.2013 We examined a sample of 38 natural spices, taken from 17 commercial units. The diagnosis was made in the Laboratory Veterinary and Food Safety Brasov, using standardized methods: yeasts and molds, Enterobacteriaceae, Salmonella spp and Total Number of Germs . Each sample consisted of 5 units. The natural spices examined were contaminated grain of mustard yellow (parameters: Yeasts + Molds, Enterobacteriaceae and Total Aerobic Plate Count) and black pepper (the parameters: Yeasts + Molds and Total Aerobic Plate Count. Black pepper, cinnamon and bay leaves were irregular in a single parameter, and nutmeg, coriander and cumin were not contaminated with bacterial germs and molds. In terms of significance, the presence Enterobacteriaceae an indicator of faecal contamination, fungal contamination of a deterioration of the structural elements of defense, increased humidity and improper storage temperature, and an indicator of poor hygiene Total Aerobic Plate Count processing.*

Key words: natural spices, microbiological contamination, laboratory diagnosis

1. Introduction

Spices are produced without nutritional value (or low nutritional value), which is added to food in small quantities to give them special taste (taste, odor, flavor) higher, thus stimulating gastric secretions, appetite and digestion. They can lead to improved flavor, taste and increase shelf life of food is added.

Spices effect is caused by the presence of chemical composition seasoning properties: essential oils, aldehydes, esters, ketones, alcohols, hydrocarbons, terpene resins, etc.. This effect taste should not be used for hedging purposes or manufacturing deficiencies that occur as a result of alteration processes food. Unfortunately, some manufacturers sometimes used fraudulently spices to mask the smell and taste defects in materials prepared with questionable freshness.

Spices are classified according to the nature, origin and organoleptic characteristics of the following groups: natural spices themselves: flowers, fruit, leaves, rhizomes, seeds, bark of plants seasoning.

Use fresh or dried (and some frozen - ex. parsley, dill, lovage, etc.) or serve as raw material for extraction of substances seasoning, spices acidic seasoning products

[1] Prof.Dr.Transilvania University of Brasov - Faculty of Food and Tourism
E-mail: gpuchianu@yahoo.com

industry (table mustard, condiment sauces) oils ether and oleo-resins, spices salt (table salt).

The microorganisms that may be present in the spices are usually resistant to drought conditions, so that the seasoning can be found in most gram-positive bacteria or spores and fungal spores.

Initial micro spices derived from the plant and the soil were cultured at which the added microflora dust coming from their contaminated during the collection and handling of faecal contamination of rodents and insects, from the water used in processing, etc. Fungal contamination can come from first or added microflora during storage and transportation. The ground spices the total number of microorganisms is generally the same as that of the whole spices, if grinding was done under hygienic conditions.

2. Materials and Methods

During the period 1.01.2012 - 30.04.2013 we examined a number of 38 samples taken from 17 natural spices trading units.

Varieties studied were:

-yellow mustard seeds (Sinapis alba) - seeds mature, dry, spherical, with a diameter of 2.0-2.5 mm;

-black mustard seeds (Sinapis nigra) - mature seeds, dry, spherical, with a diameter of 1.0-1.5 mm brown red;

-black pepper (Piper nigrum) - unmatured whole grains, dry, wrinkled, pale gray-brown, 4-5 mm in diameter;

-ground black pepper - powder;

-cinnamon (Cinamomum ceylonicum) - shell, twisted dry;

-nutmeg (Myristica fragrans Houtte) - dried seeds, hulled, with a length of 15-30 mm, a thickness of 10-20 mm, the yellow-brown;

-coriander (Coriandrum sativum) - ripe fruits, dried spherical with a diameter of approx. 3 mm, yellowish-brown;

-cumin seeds (Carvum carvi) - ripe fruits, dried long 4-6 mm, color gray-brown;

-laurel (Laurus nobilis) - leaves 5-6 cm long and 2-3 cm wide, dry, shiny, green. (Table 1 and Photos 1- 9).

The diagnosis was made according to the standards of work, and ISO 21528-1 or 2 for *Enterobacteriaceae*, ISO 21527/1 or 2 for *yeasts and molds*, ISO 6579/2003 AC/2006 for detection of *Salmonella spp*. EN ISO 4833 for detection *Total Aerobic Plate Count*, samples made up of 5 parts, as follows:

Table 1. Varieties, number of samples and of establishments whwew they were taken of

No. Crt	Specification	No. establishments from which samples were taken	No. Samples /No. Units
1.	Yellow mustard seeds	2	6/30
2.	Black mustard seeds	1	3/15
3.	Black pepper grains	3	5/25
4.	Graund black pepper	3	4/20
5.	Cinnamon	2	7/35
6.	Nutmeg	2	3/15
7.	Coriander	1	2/10
8.	Caraway	1	2/10
9.	Dafin	2	6/30
	TOTAL	17	38/190


Photo 1. Yellow mustard seeds


Photo 2. Black mustard seeds


Photo 3. Pepper grains


Photo 4. Pepper ground


Photo 5. Cinnamon


Photo 6. Nutmeg


Photo 7. Coriander


Photo 8. Caraway


Photo 9. Dafin

Enterobacteriaceae detection. Use colony-count technique at 37°C on solid medium violet red bile glucose agar (VRBG).
For the purpose of the laboratory has the following stages: making decimal dilutions, seed by pouring into each Petri dish 15 ml VRBG, previously cooled to 37°C to 47 °C in a water bath, the incubation for 24 hours at 37 °C; examination for the presence of *Enterobacteriaceae* colonies considered, calculation of the number of CFU of *Enterobacteriaceae* per gram. Typical colonies are pink to red or purple (with or without halos precipitates) are selected at random five such colonies for passage to confirmatory biochemical tests; alleged *Enterobacteriaceae* colonies were restreaked on nonselective medium, oxidase reaction and confirmed using biochemical, oxidase test and fermentation test.
Colonies that are negative at oxidase test and positive at glucose test confirmed as *Enterobacteriaceae* (Photo 10).

Photo 10. Oxidase and fermentation tests

Determination of yeasts and molds. The procedure establishes general guidelines for counting viable yeasts and molds in products intended for human consumption colony count technique at a temperature of 25°C. *Yeasts and molds* - are microorganisms that form colonies at 25°C specific selective medium.
To achieve diagnosis following steps have: they took two sterile Petri dishes. With a sterile pipette to last in each case 1 ml of the initial dilution. Each box denotes the number of sample dilution and time. They took two sterile Petri dishes. With another sterile pipette, to each 1 ml of dilution trcut 10^{-1} (liquid product) or 1 ml of 10^{-2} dilution (other products) in each box. In some cases, the procedure was repeated with different dilutions. There are many dilutions were prepared so that in a Petri dish to obtain more than 10 and less than 150 colonies. It was poured approximately 15 ml of yeast extract medium cloranfenicol dextrose agar (MEDDCA) and / or agar DG 18, previously melted and kept at 45^0

± 1^0 C in a water bath, in each Petri dish. The time between the end of the initial suspension preparation (dilution 10^{-1} or if the product is liquid) and when it is poured into the boxes Petri did not exceed 15 min. The inoculum was mixed thoroughly with the environment, and the mixture was allowed to solidify, after which the Petri dishes were placed on a flat, cold. Witness box was prepared with 15 ml medium for checking sterility. Aerobic incubation was performed at 25^0C boxes for 4 or 5 days, after which we proceeded to calculate the number of yeasts and molds per gram or ml of sample from the number of colonies obtained in the dilution chosen boxes that enable a significant result .

After three, four and five days of incubation colonies were counted in each Petri dish is retained the boxes that contained less than 150 colonies.

Photo 10.
Penicilium urtice and *Fusarium nivale,* medium colonies DDCA (original)

Photo 11.
Aspergillus citrinum, Penicilium urticae medium colonies DDCA (original)

Photo 12.
Rodothorulla rubra, Rodothorulla mucilaginosa medium colonies DDCA (original)

Number of yeasts and molds per gram or ml was calculated using the following formula:

$$N = \frac{\Sigma C}{(n_1 + 0,1\ n_2) \times d}$$

where:*ΣC* – amount of colonies counted in all boxes, n_1 – number of boxes retained colonies first dilution, n_2 - number of boxes held at the second dilution, d – the dilution of which the first counts were made (for example 10^{-2}).

The result is expressed as a number between 1.0 and 9.9 multiplied the 10x where x is the power of 10.

If there is no initial colony suspension in appropriate containers as starting material was solid, the number of yeasts and molds per gram of product has been reported to be less than 10. If the sample boxes there is no colony was originally the product liquid, the number of yeasts and molds per milliliter product reported as being less than one.

Detection of bacteria in the genus *Salmonella.* To prepare the suspension of basic fraction analyzed by 25 g was added to 9 volumes (225 ml) of BPW (APT) previously brought to ambient temperature. This mixture was treated in a stomacher for one minute, avoiding foaming and removing the air from the bag as possible.

Subsequently, detection of *Salmonella spp* requiring completion of four successive phases:

1.Preenrichment in selective liquid media: BPW was inoculated at room temperature with the sample for analysis, then incubate it at 37 º C ± 1 º C for 18 h ± 2 h;

2.Enrichment in selective liquid medium: Rappaport-Vassiliadis medium with soya (RVS bullion) and Muller-Kauffmann broth Tetrathionate / novobiocin (bullion MKTTn) culture inoculated with peptone water obtained after inoculation. RVS broth is incubated at 41.5 ° C ± 1 ° C for 24 hours ± 3 hours and MKTTn broth at 37 ° C for 24 hours ± 3 hours.

Photo 13.
Rappaport –Vasilliadis medium
before and after incubation

Photo 14.
Müller –Kauffman medium
before and after the incubation

3.Isolation and identification: the cultures obtained after inoculation RVs and MKTTn. Inoculate two solid selective media: xylose-lysine-deoxycholate agar (XLD agar) any other solid selective medium complementary to XLD agar and especially suitable for lactose-positive Salmonella isolation (eg we used the Rambach). XLD and Rambach agar medium incubated at 37 º C ± 1 º C and examined after 24 h ± 3 h

4.Confirmation of the identity - after allegedly Salmonella colonies grew, they've isolated and confirmed the identity by biochemical and serological tests.

Determination of Total Aerobic Plate Count (APC). Establishes the presence or absence of aerobic microorganisms in food products examined by colony counting method at a temperature of 30°C.

The principle of the method consists in sowing towards a solid poured into two Petri dishes with a quantity of sample for analysis and sowing decimal dilutions of the sample to be analyzed or mother suspension (initial). Working dilutions were prepared so much that in a Petri dish to obtain more than 300 colonies. Sowing is done by embedding the solid culture medium or a sample of a known amount of work represented by a range of gram or decimal dilutions in Petri dishes incorporation after solidification environment.

Working methodology involves the following steps:

-Sample preparation for analysis and initial dilution.

With a sterile pipette put 1 ml of the original solution in a test tube containing 9 ml of sterile dilution. Are then dilutions, the concentration difference is 10x (decimal dilutions)

-Seeding and Incubation:

1.Take two Petri dishes in which sterile pipette 1 ml sample analyzed. Take two other sterile Petri dishes. With a new sterile pipette is inserted in each case 1 ml of the first decimal dilution of the sample to be analyzed (10^{-1}). Repeat this procedure with the following dilutions using some new sterile pipette for each decimal dilution.

2.Pour into each Petri dish that was filed about 15 ml inoculum agar or nutrient agar at 45 ±1oC white. Mix thoroughly inoculated culture medium and allowed to solidify putting Petri dish on a cold surface and horizontal.

3.Incubate the Petri dishes with the lid down. Incubation was at 30 ±1oC for 72±2 hours.

-Interpretation - after the period of incubation is done in counting colonies in each Petri dish containing no more than 300 colonies. (Photo no. 15 and 16)

-Calculating - to hold cans containing 15 to 300 colonies in the two successive dilutions.

-Expression of results.

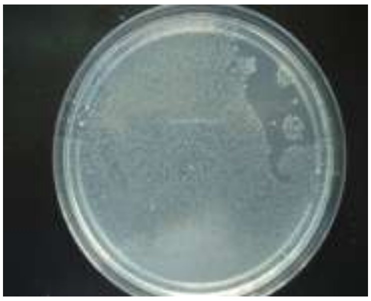

Photo 15.
Total aerobic plate count (10^{-1})

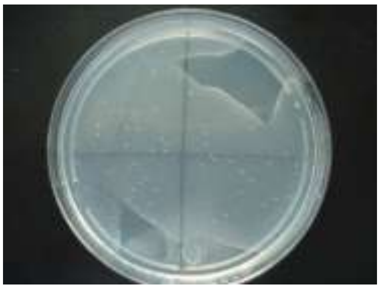

Photo 16.
Total aerobic plate count (10^{-3})

For counting boxes are used which contain less than 300 colony and at least 15 colonies. The number of organisms per ml or g of the product, is calculated as a weighted average of the following formula:

$$N = \frac{\Sigma C}{(n_1 + 0,1\, n_2) \times d}$$

where: ΣC – amount of colonies counted in all boxes, n_1 – number of boxes retained colonies first dilution, n_2 - number of boxes held at the second dilution, d – the dilution of which the first counts were made (for example 10^{-2}).

3.Results and Discussions

Microorganisms that can contaminate spices are classified impaired and pathogenic microorganisms.

Microorganisms of impaired - can cause food spoilage and subsequent spices plus. Impaired bacterial spices when it occurs, is usually caused by bacteria of the genus Bacillus (*B. subtilis, B.licheniformis, B.megaterium, B.pumilis, B.brevis, B.cereus* etc.) and *Clostridium.* Altered fungal spices is commonly produced by molds (*Aspergillus glaucus, Aspergillus niger, Penicillium spp*), some of which are able to synthesize mycotoxins dangerous to consumer health.

Pathogenic microorganisms - spices can sometimes contain antimicrobial agents that can be caused by food poisoning, especially sporogenous bacteria, anaerobes such as *Clostridium perfringens, Bacillus cereus* and *Bacillus subtilis* rare. Nesporogene gram negative bacteria also can be found in spices, usually as a result of recent contamination, eg: *Escherichia coli* and *Salmonella spp Staphylococcus aureus* is rare in spices, although bacteria resistant to dryness. *Coliform bacteria* are often found in spices, but their presence indicates, generally, recent contamination, due to their sensitivity of dryness.

Towards detecting *yeasts and molds* were examined 38 samples. Each sample was composed of five units, which means that the total number of tests performed was 190 (Table 2).

It is found that the total number of 33 samples examined were consistent fits within the values of admissibility (maximum 2 units of each sample showed values between 10^5 and 10^6 or lower values of 10^5) and a number of 5 samples representing a rate of 13.2% were non-compliant (less than 2 units of each sample showed values between 10^5 and 10^6 or greater than 10^6). Most non-compliant samples were found in black pepper (50% of total samples examined). Considerable percentage of non-compliance were recorded in other kinds of natural spices namely 16.7% from yellow mustard seeds and 14.3% the cinnamon.

This can be explained if the pepper that is a less stable microbiologically than grains, being devoid of structural elements of defense, which is why mold cleaner come in direct contact with the nutrients necessary for their development. The fungal contamination of the samples examined were determined product moisture and storage temperature likely factors that favored the emergence of alterative changes.

Table 2. Samples examined for the detection Yeasts and Molds

No. Crt	Specification	No. Samples /No. Units	Results obtained					
			Compliance			Non compliance		
			No.	%	Values cfu/g	No.	%	Values cfu/g
1.	Yellow mustard seeds	6/30	5/25	83,3	$1,2x10^3$ $1,3x10^4$	1/5	16,7	$1,11x10^6$ $1,43x10^6$
2.	Black mustard seeds	3/15	3/15	100	$1,2x10^2$ $4,3x10^4$	-	-	
3.	Black pepper grains	5/25	5/25	100	$1,25x10^3$ $2,43x10^4$	-	-	
4.	Graund black pepper	4/20	2/10	50,0	$9,4x10^4$ $9,8x10^4$	2/10	50,0	$1,85x10^6$ $2,18x10^6$
5.	Cinnamon	7/35	6/30	85,7	$4,7x10^4$ $6,5x10^4$	1/5	14,3	$1,03x10^6$ $1,09x10^6$
6.	Nutmeg	3/15	3/15	100	$8,3x10^4$ $1x10^6$	-	-	
7.	Coriander	2/10	2/10	100	$5,5x10^4$ $5,7x10^4$	-	-	
8.	Caraway	2/10	2/10	100	$1,8x10^3$ $2,9x10^4$	-	-	
9.	Dafin	6/30	5/25	83,3	$3x10^5$ $2,6x10^4$	1/5	16,7	$1,17x10^5$ $1,33x10^5$
	TOTAL	38/190	33/ 165	86,8		5/25	13,2	1,17x105 2,18x106

Towards detection of bacteria of the family *Enterobacteriaceae* were examined 38 samples. Each sample consisted of 5 units. (Table 3).

It is found that the total number of 36 samples examined were consistent fits within the values of admissibility laid down in Regulation 2073/2005 (maximum 2 units of each sample had between 100 -1000 cfu / g or lower values 100), and a total of two samples representing a rate of 5.3% was inconsistent (less than 2 units of each sample are shown between 100 -1000 cfu / g or greater than 1000 cfu / g). Percentage most non-compliant samples were found in black pepper grains (20% of total samples examined). Considerable percentage of non-compliance were recorded in other kinds of natural spices namely 16.7% from yellow mustard seeds.

Enterobacteriaceae contamination can be explained by different sources of contamination secondary intervention most likely set of non hygienic conditions during harvest and handling operations, packing, knowing that the presence *Enterobacteriaceae* are indicators of faecal contamination of the substrates on which they are found.

Table 3. Samples examined for detection spices Enterobacteriaceaelor

No. Crt	Specification	No. Samples /No. Units	Results obtained					
			Compliance			Non compliance		
			No.	%	Values cfu/g	No.	%	Values cfu/g
1.	Yellow mustard seeds	6/30	5	83,3	$1{,}2x10^2$ $3.2x10^2$	1	16,7	$4{,}6x10^3$ $4{,}8x10^3$
2.	Black mustard seeds	3/15	3	100	$1{,}2x10^2$ $1{,}65x10^2$	-	-	
3.	Black pepper grains	5/25	4	80,0	$3{,}3x10^2$ $5{,}1x10^2$	1	20,0	$1{,}37x10^3$ $2{,}5x10^3$
4.	Graund black pepper	4/20	4	100	$7{,}2x10^2$ $8{,}3x10^2$	-	-	-
5.	Cinnamon	7/35	7	100	$2{,}2x10^2$ $2{,}7x10^2$	-	-	-
6.	Nutmeg	3/15	3	100	$3{,}1x10^2$ $3.5x10^2$	-	-	-
7.	Coriander	2/10	2	100	$1{,}8x10^2$ $2{,}6x10^2$	-	-	-
8.	Caraway	2/10	2	100	$8{,}8x10^2$ $1x10^3$	-	-	-
9.	Dafin	6/30	6	100	$6{,}3x10^2$ $7{,}1x10^2$	-	-	-
	TOTAL	38/190	36	94,7		2	5,3	$1{,}37x10^3$ $4{,}8x10^3$

Table 4. Samples examined for the detection of *Salmonella spp*.

No. Crt	Specificare	No. Samples /No. Units	Results obtained					
			Compliance			Non compliance		
			No.	%	Values cfu/g	No.	%	Values cfu/g
1.	Yellow mustard seeds	-	-	-	-	-	-	-
2.	Black mustard seeds	-	-	-	-	-	-	-
3.	Black pepper grains	-	-	-	-	-	-	-
4.	Graund black pepper	1/5	1/5	100	Abs.	-	-	-
5.	Cinnamon	-	-	-	-	-	-	-
6.	Nutmeg	-	-	-	-	-	-	-
7.	Coriander	-	-	-	-	-	-	-
8.	Caraway	1/5	1/5	100	Abs.	-	-	-
9.	Dafin	1/5	1/5	100	Abs.	-	-	-
	TOTAL	3/15	3/15	100	Abs.	-	-	-

Even if the national strategy does not provide detection of bacteria of the genus Salmonella germs on request benefi we examined three samples. Each sample consisted of 5 units. (Table 4).

It is found that all samples were compliant exams consecutively germs like *Salmonella* detection, which demonstrates that the harvest conditions were adequate and complied with human handlers hygiene, the presence of *Salmonella spp* (which belong to the family *Enterobacteriaceae*) representing indicators of faecal contamination.

The national strategy even if the program does not provide the total aerobic plate detection, we request benefi examined 10 samples, each sample being composed of 5 units. (Table 5).

Table 5. Samples examined for the detection of Total Number of Germs

No. Crt	Specificare	No. Samples /No. Units	Results obtained					
			Compliance			Non compliance		
			No.	%	Values cfu/g	No.	%	Values cfu/g
1.	Yellow mustard seeds	2/10	1	50	$3,2x10^4$ $6,2x10^4$	1	50	$1,23x10^5$ $1,42\ x10^5$
2.	Black mustard seeds	1/5	-	-	-	1	100	$1,42\ x10^5$ $2,25\ x10^5$
3.	Black pepper grains	2/10	2	100	$3,2x10^4$ $6,2x10^4$	-	-	
4.	Graund black pepper	2/10	1	50	-	1	50	$3,5\ x10^5$ $4,2\ x10^5$
5.	Cinnamon	4/20	4	100	$9,1x10^4$ $1x10^6$	-	-	-
6.	Nutmeg	1/5	1	100	$7,3x10^4$ $8,21x10^4$	-	-	-
7.	Coriander	-	-	-	-	-	-	-
8.	Caraway	1/5	1	100	$6,52x10^3$ $8,8x10^3$	-	-	-
9.	Dafin	-	-	-	-	-	-	-
	TOTAL	13/65	10	76,9		3	23	23,1

It appears that out of the 10 examined samples of 7 were consistent fits within the values of eligibility, and a number of 3 samples representing 23% were irregular. Percentage most non-compliant samples were found in samples of yellow mustard seeds (100% of the samples examined). Considerable percentage of non-compliance were recorded in other kinds of natural spices namely by 50% from yellow mustard seeds and ground black pepper.

Percentages obtained are however irrelevant in terms of the number of samples examined, but they can still offer an insight aerobic microbial contamination of various kinds of natural spices.

The interpretation we made in relation to the provisions of Order 43/2012 of the President ANSVSA and Order 27/2011 (Table 6).

Table 6. Interpretation in relation to ANSVSA Provisions

Analysis to be performed	Sampling plan		Limitations	
			m	M
Enterobacteriaceae	5	2	100 cfu/g sau ml	1.000 cfu/g sau ml
Yeasts and molds	5	2	105 cfu/g	106 cfu/g
NTG	5	2		
Salmonella spp.	5	2	Abs	Abs

Conclusions

(1)In laboratory tests of 38 samples of natural seasonings, a total of five samples representing a rate of 13.2% were inconsistent in terms of fungal contamination, two samples representing a rate of 5.3% were infected with *Enterobacteriaceae* , the samples examined in the direction of detection of bacteria in the genus *Salmonella* were in line, and a total of 3 samples representing a rate of 23% were inconsistent in terms of *Total Number of Germs.*

(2)The natural spices examined were contaminated grain of mustard yellow (parameters: *Yeasts and Molds*, *Enterobacteriaceae* and *Total Number of Germs*) and black pepper (the parameters: *Yeasts and Molds* and *Total Number of Germs*). Black pepper, cinnamon and bay leaves were irregular in a single parameter, and nutmeg, coriander and cumin were not contaminated with bacterial germs and molds.

(3)*Enterobacteriaceae* presence of an indicator of faecal contamination, fungal contamination of a deterioration of the structural elements of defense, increased humidity and improper storage temperature, and an indicator of poor hygiene *Total Number of Germs* processing.

(4)Indicates the presence of bacteria usually recent contamination, due to their sensitivity of dryness. Some of the molds that contaminate spices may be able to synthesize mycotoxins dangerous to consumer health.

(5) Can contaminate food spices are incorporated microbiologic can produce their alteration.

References

[1] Bârzoi D., Meica S., Neguţ M.,1999, Food poisoning. Diaconu Coresi Publishing, Bucharest.

[2] Bârzoi D., Apostu S., 2002, Microbiology of food. Risoprint Publishing, Cluj Napoca.

[3] Necula V., Babii Mihaela, 2010, Food, nutrition and their impact on consumers. Transilvania University of Brasov Publishing.

[4] Necula V., Babii Mihaela, 2012, Sensory analysis of foods and food products. Transilvania University of Brasov Publishing.

[5] Puchianu G., 2012, Microbiological criteria for food safety and process hygiene. Transilvania University of Brasov Publishing.

[6] Răpuntean G, Răpuntean S., 1999, Special Veterinary Bacteriology. Publisher Tipo Agronomy, Cluj - Napoca.

[7] Rotaru O, Mihaiu M., Dan S., 2006, Control of animal health products. Publisher Risoprint Cluj - Napoca.

[8] Rotaru O, Mihaiu M., 2002, Pathology of the food. Todesco Publishing Cluj – Napoca

[9] Rusu L, Neagu M., 2011, Food Safety - Food Quality. Spiru Haret Publishing Science.

[10] Savu C., 2008, Hygiene and control of animal products. Signs Publishing.

[11] Ştirbu C., Turcu D., (1999) - Getting bacteriology. Publisher Brumaire, Timişoara.

[12] Order no. 17 Methodological Norms for the application of Timetable for surveillance, prevention and control of animal diseases, of those transmissible from animals to humans, animal welfare and environmental protection for 2011 and the surveillance and control program in the field of food safety 2011.

[13] Working methodology for detecting bacteria in the genus Salmonella - standard SR EN ISO 6579/2003 AC/2006 "Microbiology of food and animal feeding stuffs - Horizontal method for Salmonella spp research Commission Regulation no. 2073/2005 / EC.