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RESEARCH ARTICLE

STUDY OF THE SOCIO-ECONOMIC IMPORTANCE AND ARTISANAL TECHNOLOGY OF FERMENTED AND SALTED FISH (LANHOUIN) PRODUCED AND SOLD IN LOMÉ

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Abstract

To study the socio-economic importance and technology of fermented and salted fish produced and sold in Lomé, a survey was conducted. The sampling method was exhaustive. The questionnaires administered to the 13 producers and 14 sellers covered their socio-demographic characteristics, their knowledge of Good Hygiene and Manufacturing Practices, the lanhouin process and the economic importance of their activities. The production and marketing of lanhouin in Loméarenational activities that are carried out entirely by women. Their age varies from 30 to over 60 years and their experience in the sector is from 1 to 60 years. The majority have not been educated. All of them have not received any training in good hygiene and manufacturing practices. The fish species most commonly used in the production of lanhouin are Pseudotholithus senegalensis and Decadacttylus galeides. The production flowchart includes the following key steps: maturation, salting, fermentation. These steps are completely uncontrolled. In addition, the washing of the fish is done with water from uncovered wells. Fermentation is spontaneous and takes place in plastic or cement jars. Finally, drying after fermentation is not practiced. These conditions would constitute critical points for microbial and toxicological contamination. In economic terms, the production or sale of Lomé lanhouin has an individual monthly turnover of 1,200,000 CFA francs (about $600) for more than 92% of them. These results show the contribution of the Lanhouin sector produced and sold in Lomé to women's autonomy. They also reveal the need to control its artisanal manufacturing process.

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Introduction:-

Fermented and salted products are known by different names depending on the production area: plaa-som in Thailand (Kopermsub and Yunchalard, 2010), makayabu in Congo (Dossou-Yovo, 2002). momoni in Ghana (Sanni et al., 2002),adjuevan in Côte d'Ivoire (Koffi-Nevry et al., 2011). lanhouin in Benin (Anibouvi et al., 2006). In Togo, it is also known as lanhouin and is produced through traditional processes. It is characterised by specific qualities of aroma, flavour and colour that are sought after according to consumer preferences and the dietary habits of the populations. Lanhouin is thus fermented and salted fish, used as a flavour enhancer by people in Togo to season mainly vegetable sauces, but also tomato and smoked fish sauces, and sometimes even fatty rice and fried food (Anihouvi et al., 2005). It is a very popular condiment for its consumers.

Nutritionally, lanhouin is rich in protein, which represents up to 25% of the wet matter according to Anihouvi et al. (2005). It is also a significant source of polyunsaturated fatty acids (Dossou-Yovo et al. , 2016).

Economically, lanhouin is a condimentthat all social classes can afford. It is enough to have fifty (50) CFA francs to buy it and to prepare a dish with the characteristic taste of lanhouin for a whole family. Thus, even people with very low incomes in Togo consume it.

Studies have been conducted in Benin, Côte d'Ivoire, Ghana and Senegal (Anihouvi et al., 2005; Sanni et al., 2005; Kouakou et al., 2013; Fall et al., 2014) to describe the technology, nutritional and socio-economic importance and microbiological quality of this fermented and salted fish. In Togo, no study on lanhouin has been carried out while those previously conducted seem to specify specificities in the manufacturing processes from one country to another (Fall et al., 2019). It is to contribute to the knowledge of the Lomé lanhouin that the present study was conducted. The objective is to study the socio-economic importance and artisanal technology of fermented and salted fish produced and sold in Lomé.

Materials And Methods:-

A socio-economic survey was carried out in Katanga and Kodomé market in the city of Lomé, in southern Togo. These two locations were chosen because of the importance of the country's lanhouin producers. Two types of questionnaires were designed: one for producers and the other for traders. The size of the population surveyed was 27, including 13 female producers in Katanga and 14 female traders at the Kodomé market.

The sample is exhaustive. Only producers and traders of lanhouin produced in Togo were included in this study. Traders of lanhouin produced outside Togo were excluded.

A structured survey supported by a questionnaire made it possible to collect data from producers and traders on their socio-professional characteristics, including age, gender, level of education, length of time in the trade, knowledge of good manufacturing and hygiene practices and the lanhoiun processing process. The environment surrounding lanhouin production was also assessed. The quantities produced and marketed, as well as the income generated by these activities were also assessed.

Results and Discussion:-

Characteristics of Lomé lanhouin producers and traders

The production and marketing of fermented and salted fish is a predominantly female national activity as in Benin (Anihouvi et al., 2006). The proportion of women who have not been educated is higher(Table1). But increasingly, some women with a first level of education (CEPD) and a Patent of undergraduate study(BEPC) are interested in this activity. It is therefore to be expected that good hygiene and manufacturing practices will be better taken into account in the sector. However, today, the observation made is the total absence of these good practices.

Table 1:- Socio-demographiccharacteristics of women producers and sellers of lanhouin produced and sold in Lomé.

Characteristic		Proportion (%)	
		Producers (n=13)	Vendors (n= 14)
Gender	Female	100%	100%

	Male	0%	0%
Age group	30-50 years 51-60 years	30,77% 53,85%	53,85% 38,46%
	>60 years	15,38%	14,29%
Nationality	Togolese	61,54%	78,57%
	Other	38,46%	21,42%
Exercise period	1-20 years 21-40 years 41-60 years	38,46% 53,85% 7,69%	38,46% 30,77% 38,46%
Level of education	BEPC CEPD No	15,38% 38,46% 46,15%	 100,00%

There are 13 women producers in Katanga. At the Kodomé market, the women who sell lanhouin produced in Togo are also producers. In number of 14, from Kpogan, Agborafo, Agbavi and Avépozo. They go to the market when they cannot sell the lanhouin at the production site. The age of these women varies from 30 to over 60. Some of them have only been doing this for a year, while others have been doing it for 60 years. The production and sale of lanhouin are sustainable activities that deserve to be developed. The women are initiated into it from childhood and are financially autonomous at a very early stage, despite not having attended school.

Artisanal processing of lanhouin produced in Lomé

Processes

The artisanal technology of fermented and salted fish (lanhouin) produced and sold in Lomé follows the diagram shown in Figure1. The two processes identified in this study have trimming, washing, salting and fermentation in common. The difference is that one of the methods includes a prior maturation stage, which is estimated to last 12 hours. The process without maturation is used for small fish, while the second method including maturation is often used for large fish. The finished product obtained from the second method often has a texture more appreciated by consumers. This is because maturation is marked mainly by the softening of the fish flesh through natural autolysis, under the action of endogenous enzymes and microorganisms. It is also at this time that the flavour of the lanhouin develops according to Anihouvi et al. (2012). However, this stage is not without impact on the microbiological and toxicological qualities of the fish because microbial multiplication is certainly important and biogenic amines can be produced at this stage. In order to limit enzymatic and microbial activities, Anihouvi et al. (2012) estimated that the maturation time should be between 8 and 10 hours.

Salting is done either in brine or dry, depending on the species of fish, as in Côte d'Ivoire in the Adjuevan sector (Kouakou et al., 2013). Coarse sea salt without iodine is used by 92.23% of producers because of the lower cost and better texture of the fish flesh obtained with this type of salt. Indeed, salt increases the solubility of some muscle proteins, which helps to express their technological properties, including the improvement of the final texture of the flesh (Fall et al., 2014). The amount of salt added at the salting stage depends on the size and mass of the fish. But it is not measured. According to Anihouvi et al. (2012) in Benin, for a better sanitary quality lanhouin,the salt used should vary between 20 and 35% of the mass of the fresh fish for dry salting and about 15 to 25% for salting in brine.

According to 75% of the producers, spontaneous fermentation usually takes 7 days. But this time can be reduced to 5 days for small and medium sized fish when lanhouin is inshort supply on the market. The duration of fermentation is almost the same in Benin and Togo. However, Kouakou et al.(2013) in Côte d'Ivoire found 3-5 days of fermentation for adjuevan. In Thailand, fish can be fermented for up to 12 days for plaa-som and two months for kapi (Paludan-Müllera et al., 2002).

The artisanal lanhoiun technology in Lomé seems to have many similarities with that of Benin described by Fall et al. (2014). However, there are some differences, especially in the final stages of drying, which is not practiced in Lomé. According to Anihouvi et al.(2005), drying reduces the water content of lanhouin. If drying is not

practiced, the water content in Lomé lanhouin would be maintained and would thus contribute to the development of microorganisms.

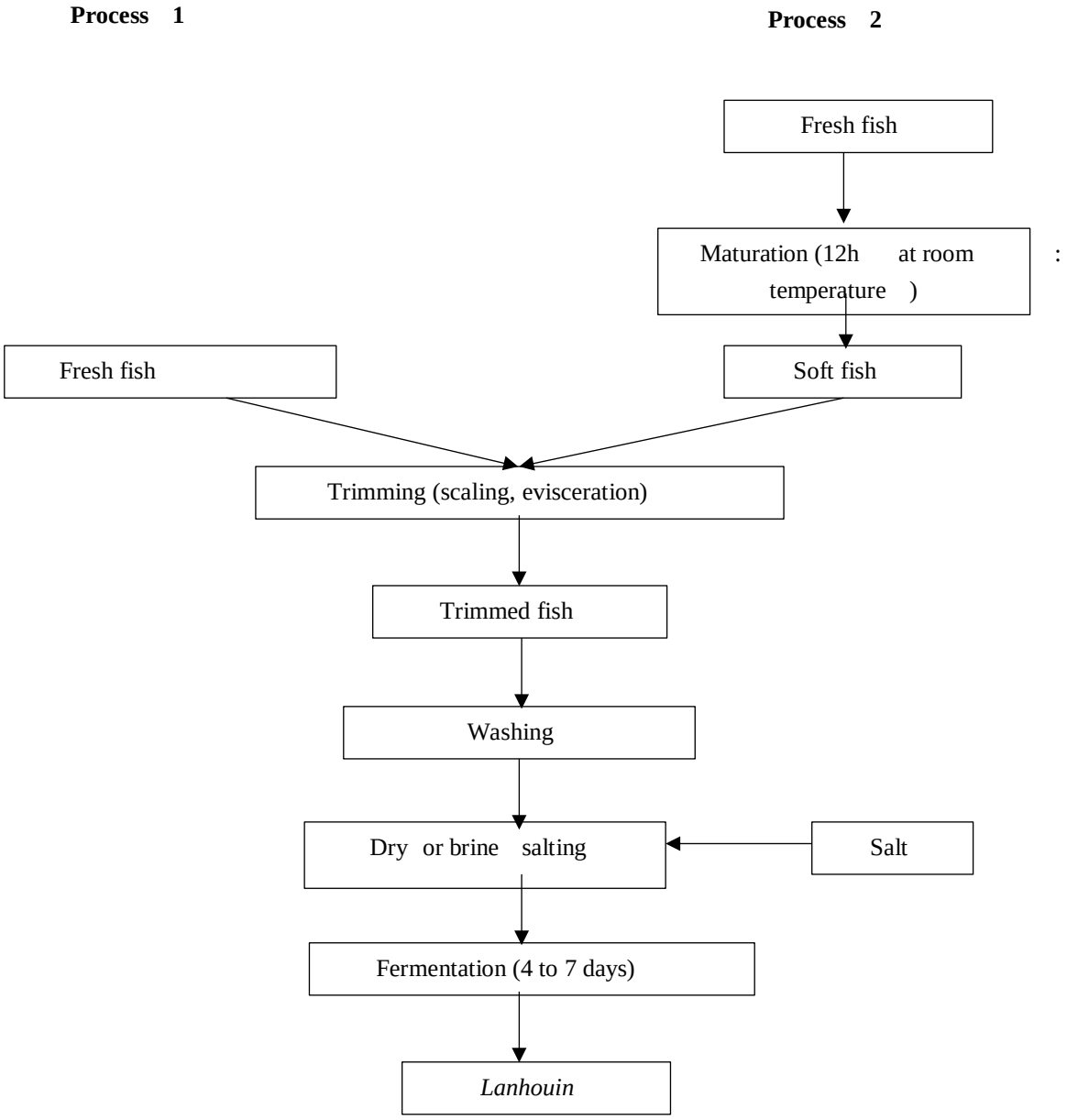


Figure1:- Lanhouin production processes in Lomé.

After the lanhouin is obtained, it can be stored for 2-5 months in a fly-proof place with sufficient salt. Here again, the salt is not quantified. On the other hand, if it is poorly preserved, the lanhouin loses its aroma, giving it a pasty and unpleasant appearance. The work of Kouakou et al (in 2013) in Côte d'Ivoire reported that pungent odours, itching and nausea are sometimes observed following the consumption of poorly preserved fermented, salted and dried adjuvan fish.

The production diagram of lanhouin in Lomé shows that maturation, salting and fermentation are uncontrolled. These critical points of production deserve to be improved for a good sanitary quality of lanhouinand Anihouvi et al.(2015) have made many suggestions in this regard. According to these authors, maturation should be done in brine to initiate dehydration. This brine also reduces the microbial flora and the production of biogenic

amines allowing a better stabilisation and a better organoleptic quality of the finished product. Fermentation should last 2 to 7 days for the development of characteristic flavours, while controlling the microbiological quality of the product. Immersion of the fermented salted fillets in a solution of garlic extract and lemon juice has bacteriostatic and insect repellent effects. This results in a better preservation of the finished product during storage. The finished product is protected from dust and flies by a shell dryer.

Production environment

Plastic tubs are used throughout the lanhouin production process. On the other hand, aluminium basins are used in 38.46% of cases in the stages upstream of salting. Cement jars are used in 69.23% of cases in the fermentation stages. This widespread use of plastic is linked to the fact that it is cheaper and resistant to the action of salt. Compared to cement, which is difficult to maintain, and aluminium, which is quickly eaten away by salt, stainless steel would be a suitable material. But the container made of this material would be more expensive.

Washing and brining are done with water from the usually uncovered shallow well. These waters can contain germs due to the infiltration of faecal matter. Indeed, Soncy et al (2015) showed that well water in Lomé was highly contaminated with germs indicating faecal contamination. These germs can be found on lanhouin washed with these waters.

Species used for lanhouin production in Lomé

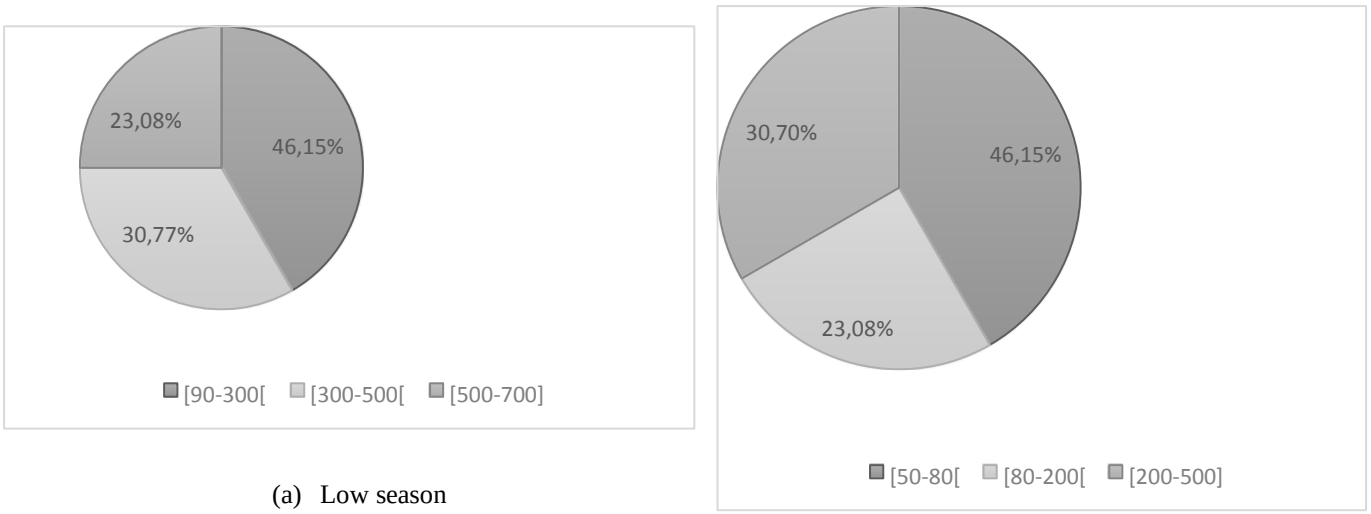
In the process described in Figure 1, the raw material corresponds to the fish species presented in table2. Pseudotholithus senegalensis and Decadacttylus galeides are the most used because of their good technological performance. Scomberomorus tritor, Balistes capriscus and Lethrinus atlanticus are also used but to a lesser extent. They are cited by 78.57%, 57.14% and 35.71% of lanhouin producers respectively. Small fish such as Sardinella and anchovies(Engraulisencrasicolus) are used very little in lanhouin processing.

Table 2:- Species of fish used for the production of lanhouin (list provided by the Fisheries Directorate).

Scientific names	Common names	Local names (ewe)
Balistes punctatus	Ballista	Akpagba/Egbo
Balistes capriscus	Ballista	Akpagba
Caranx hippos	Carangue	Panpan
Caranx crysos	Carengue	Panpan/Tsii
Decadacttylus galeides	Hornose or false Captain	Tsikoé
Dentex canariensis	Pink sea bream	Sica -sica
Lethrinus atlanticus	Grey sea bream	Sipklin
Lutjanus dentatus Lutjanus goreensis	 Lutjanus	Ehan/Agnato
Lutjanus fulgens Pagrus caeruleosticus	Pink sea bream	Sica-sica
Pagellus bogaraveo Pagellus bellottii Pseudotholithus senegalensis	Pageot Bar	Sica -sica Ekan
Scomberomorus tritor	Mackerel	Zandou
Sphyraena guachancho Sphyraena sphyraena	Pike	Lizi

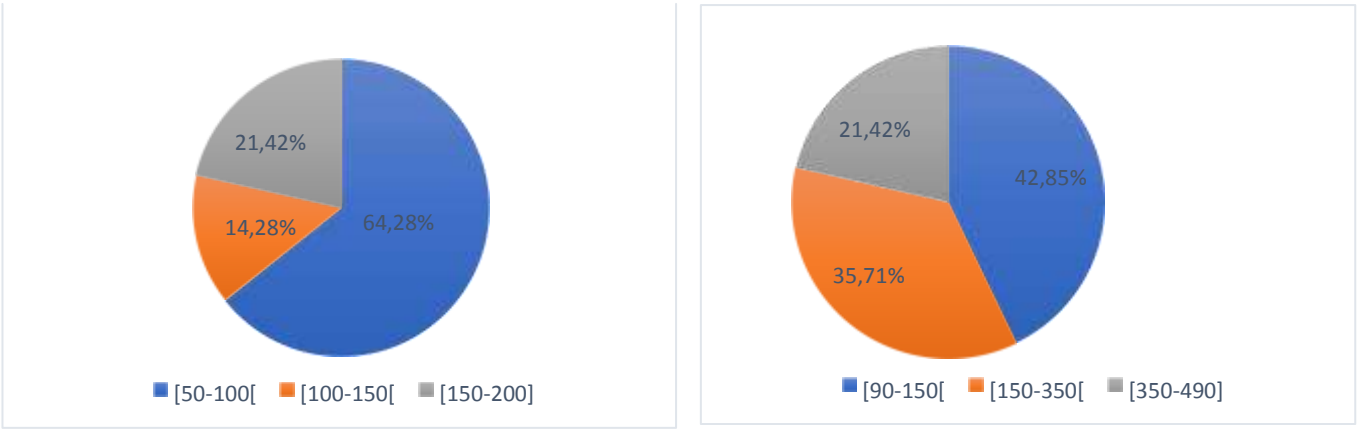
Economic aspect of lanhouin production and marketing

The production of lanhouinin Katanga varies from season to season. During the so-called low season (February - April), when fish is not abundant, the amount of lanhouin produced ranges from 50 kg to 500 kg per week and per person. During the high season (July-October), lanhoiun production can reach 700 kg (Figure 2). The turnover of women producers of fermented and salted fish is thus between 600,000 CFA francs (US$1000) and 1.200.000 CFA (US$2000). This activity generates significant income for these producers. Indeed, they declared that they could provide for their families and even save money. In Benin and Senegal, the production of lanhouin (Anihouvi et al., 2005) and guedj (Fall et al., 2014) is considered a lucrative activity.



(a) Low season (b) Highseason

Figure2:- Quantity (kg) of lanhouin per producer per week in high season (a) and low season (b).



(b) Low season **(b)**High season

Figure 3:- Quantity (in kg) of lanhouin sold by women traders in the low season (a) and in the high season (a).

Like production, the sale of lanhouin is a source of income. Thus, 42.85% of traders sell up to 150 kg per week in high season and 64.28% sell up to 100 kg per week in low season (Figure3).

The turnover is also estimated to be between 320,000 FCFA and 1,200,000 FCFA per month for 93.72% of traders. The production and marketing of lanhouin generates substantial income.

According to Anihouvi et al. (2005), this activity is also very profitable in the Republic of Benin.

Conclusion:-

Women are the actors in the production and marketing of fermented and salted fish produced in Lomé. This is a female activity that should be encouraged because the income it provides is substantial and contributes to their financial independence. They have no training in good hygiene and manufacturing practices. The conditions surrounding the production of this commodity are detrimental to its microbiological and toxicological qualities.

The processing of lanhouin in Lomé is entirely artisanal and uncontrolled with two variants. Ripening is prior in one of the variants and drying at the end of the process is absent in both processes. This can lead to a questionable quality of the lanhouin produced in Lomé. It is therefore necessary to carry out a microbiological analysis of these

fermented and salted fish to complete the present study. The improvement of the artisanal production technique is equally important.

Ethical consideration
The authors state that they have respected all ethical considerations in this study.

Sources of Support
None.

Declaration of Competing Interest
The authors report no declarations of interest.

Author Contributions
Conceived and designed the experiments: ATAKORA Magnou-léléng and DOSSOU Bayi Reine. Sampling and questionnaire administration: ATAKORA Magnou-léléng. Performed the experiments and analyzed the data: ATAKORA Magnou-léléng, DOSSOU Bayi Reine, SONCY Kouassi, ANANI Kokou and KAGNI-DOSSOU Mensah. Contributed reagents/materials/analysis tools: KAROU Damintoti Simplice, AMÉYAPOH Yaovi and GBÉASSOR Messanvi. Wrote the paper: DOSSOU Bayi Reine, ATAKORA Magnou-léléng and MELILA Mamatchi.

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Bibliographic References:-

1. Anihouvi V. B., Hounhouigan J. D., Ayernor G. S. 2005. Production et commercialisation du "lanhouin", un condiment à base de poisson fermenté du golfe du Bénin, Cahiers Agricultures vol. 14, n° 3. Pp323-330.
2. Anihouvi V. B., Toudonou H. J, Akissoe N. H and Hounhouigan J. D. 2012. Essai de mise au point d'un ferment pour la production artisanale du Lanhouin, un condiment à base de poisson fermenté au Bénin, Bulletin de la Recherche Agronomique du Bénin (BRAB) Numéro 72, en ligne (on line) sur le site web http://www.slire.net ISSN sur papier (on hard copy) : 1025-2355 et ISSN en ligne (on line) : 1840-7099.
3. Anihouvi V.B, Ayernor G.S, Houihouigan J.D, Sahyi-Dawson E.. 2006. Quality characteristics of lanhouin: A traditionally processed fermented fish product in the Republic of Benin. African Journal of Food, Agriculture, Nutrition and Development 6; page 1-15.
4. Anihouvi VB, Kindossi J, Hounhouigan J, Devillers J, Boucher MG, Doucet P. 2015. Guideline for the industry for lanhouin; African Food Tradition rEvisited by Research (AFTER) Project, Deliverable 7.1.1.6; Technical Guide, 18 p
5. Dossou-yovo P. 2002. Biochemical justification of the improvement of traditional lanhouin production processes in Benin. PhD thesis, defended in Astrakhan, Russia.
6. Dossou-Yovo P., Josse R. G., Yélouassi C. A. R.. 2016. Status of fatty acids of Scomberomorus tritor subjected to fermentation for obtaining lanhouin, International Journal of Innovation and Applied Studies ISSN 2028-9324 Vol. 16 No. 4 Jun. pp. 758763.
7. Fall M, Diop M. B., Montet D., Maiga A Sand Guiro A. T. 2019. Fish fermentation in West Africa and societal challenges for product quality improvement (adjuevan, guedj and lanhouin): a literature review, Cahiers Agricultures. 2019, 28, 7 https://doi.org/10.1051/cagri/2019007
8. Fall N.G., Tounkara L.T., Diop M.B., Thiaw O.T., Thonart P. 2014. Socio-economic and technological study of fermented and salted and dried fish (Guedj) production in Senegal. International Journal of Biological and Chemical Sciences, 8(6): 2523-2538.
9. Halasz A., Barath A., Simon-Sarkadi L., Holzapfel W. 1994. Biogenic amines and their product by micro-organisms in food. Trends in Food Science and Technology, **5** (2): 42-49
10. Koffi-Nevry R., Ouina T.S, Koussemon M. & Brou K. 2011. Chemical Composition and Lactic Microflora of Adjuevan, a Traditional Ivorian Fermented Fish Condiment. Pakistan Journal of Nutrition 10 (4): page 332-337.
11. Kopermsub P. and Yunchalard S. 2010. Identification of lactic acid bacteria associated with the production of plaa-som, a traditional fermented fish product of Thailand. International Journal of Food Microbiology 138 (3): page 200-204.

12. Kouakou A.C, Kouadio F.N.G., Dadie A.T, Montet. D., Djè M.K. 2013. Production and marketing of adjuevan, fermented and salted fish from Côte d'Ivoire. Cahiers d'agriculture 22: 559.
13. Paludan-Müllera C, Madsen M, Sophanodorac P, Grama L, Møller P. 2002.Fermentation and microflora of plaa-som, a Thai fermented fish product prepared with different salt concentrations, International Journal of Food Microbiology Volume 73. Pages 61-70.
14. Sanni A. I., Asiedu M. & Ayernor G. S. 2002. Microflora and Chemical Composition of Momoni, a Ghanaian Fermented Fish Condiment. Journal of Food Composition and Analysis 15 (5): page 577-583.
15. Soncy K., Djeri B., Anani K., Eklou-Lawson M., Adjrah Y., Karou D.S. Ameyapoh Y. de Souza C. 2015. Evaluation of the bacteriological quality of well and borehole water in Lomé, Togo, Journal of Applied Biosciences 91:8464 - 8469 ISSN 1997-5902, http://dx.doi.org/10.4314/jab.v91i1.6.