

fessor Atwater gave as the evidence obtained from the study of American dietaries:

	Nutritive ratio
Woman with light muscular work.....	1 : 5.5
Man without muscular work.....	1 : 5.6
Woman with moderate muscular work.....	1 : 5.6
Man with moderate muscular work.....	1 : 5.8

In the third column of Table V, the heat of combustion is given in calories per kilogram. The values are calculated by the use of Rubner's factors: 4.1 calories for a gram of protein, the same for a gram of carbohydrate, and 9.3 for a gram of fat.

It will be observed that rice gives the widest nutritive ratio, 1 : 14.1, owing to the large amount of starch present; the same may be said of frame food, 1 : 9.0; soya beans, with 1 : 1.3, and green flagorets, with 1 : 1.9, show the narrowest. Provost barley and oats, 1 : 4.4, is perhaps the most satisfactory ratio on the list.

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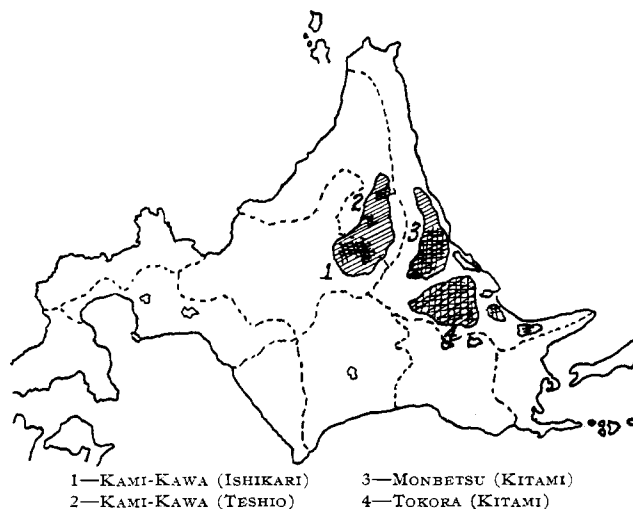
PEPPERMINT OIL INDUSTRY IN JAPAN

By YEINOSUKE SHINOSAKI

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Nowadays the Japanese peppermint fields are commenced at Kami-Kawa (in the province of Ishi-

becoming the principal districts of the cultivation and the oil production in Japan; at least ninety per cent of the total production of the oil in Japan comes from the said districts.



The first peppermint cultivation in Hokkaido was commenced at Kami-Kawa (in the province of Ishi-

Name of the district	Principal villages	Cultivated area Acres		Oil products Weight in lbs.		Price in dollars		Number of producers		Number of laborers	
		1910	1911	1910	1911	1910	1911	1910	1911	1910	1911
Tokoro (Kitami)	Notsukeushi	2,588	3,244	88,000	73,128	132,000	164,538	1,074	1,089	1,998	1,989
Monbetsu (Kitami)	{ Kamiyubetsu Shimoyubetsu }	2,193	3,091	82,800	114,947	84,200	224,146	895	955	2,025	1,613
Abashiri (Kitami)	Mihoro	140	142	3,813	3,827	5,720	5,740	30	30	70	70
Kami-Kawa (Ishikari)	{ Aibetsu Nagayama }	1,135	1,676	35,323	34,567	46,608	64,425	172	221	660	698
Kami-Kawa (Teshio)	{ Shibetsu Kaminayoro }	287	450	9,200	15,307	13,775	64,502	68	162	302	601
All others.....							32,251				
Total.....		6,343	8,603	219,136	241,776	282,303	491,100	2,239	2,457	5,055	4,971

chiefly located in Hokkaido, Okayama and Hiroshima prefectures. Formerly Okayama and Hiroshima had

kari) by the immigrants from Yamagata prefecture. Now the most important center in this place is the province of Kitami, in which Notsuke-Ushi (Tokora), and Yubetsua (Monbetsu) are again the chief places of the production.

In 1910 and 1911 the total production in this place amounted to about 110 and 120 tons, the details of which are to be given presently in a tabular form.

The accompanying map illustrates the chief peppermint districts in Hokkaido.

CULTIVATION

There are two varieties of Japanese peppermint, *Mentha Arvensis*, known as the "Aomaru" and "Akamaru" mint. The former is noted for its vigorous propagation but is inferior in quality. The Japanese peppermint oil is, therefore, prepared from the Akamaru mint.

The stem of the Akamaru variety presents a violet-red color which disappears as the plant



PEPPERMINT FARM AT NOTSKEUSHI VILLAGE IN TOKORO (KITAMI)

controlled the market, but during nearly the last six years the industry in Hokkaido has superseded others.

grows. The petals of its flower are of light violet color. In Hokkaido the mint sprouts in the spring and blossoms in the autumn. It is generally cultivated in a district of warm and dry alluvial soil. Being a perennial plant, the mint contains the largest amount of oil two or three years after its original planting. After a certain period, however, the oil is gradually reduced. It is, therefore, transplanted in newly opened districts when the farms become four or five years old.

The quality of Japanese peppermint oil is inferior to that of German and English origin, chiefly on account of its bitter taste. To improve the quality, the peppermint of English and German origin was put on a trial cultivation at the Katami Branch of the Agricultural Experimental Station of Hokkaido a few years since.

CUTTING AND DRYING

Before frost sets in, the peppermint harvesting is carried on annually on a dry day in September, when it is in full bloom. The cuttings are tied up in bundles and then bound into a series of small sheaves with straw ropes. These are dried by hanging on shelves constructed upon the roofs of farm cottages or drying huts, especially built for the purpose. They require three or four weeks for complete drying. The harvest from one acre is about 2200-3300 lbs. of the dried herb.

DISTILLATION

The peppermint oil is prepared by the steam distillation of the dried herb, which is carried out by the farmers in the intervals of farming (from the middle

wooden vat with a small opening in the center of the bottom. The condenser is a cast iron kettle of inverted conical form. This apparatus is an old type of the kind and is especially employed by the immigrants from the Yamagata prefecture.

In carrying out the process, the boiler is filled with water and then hearth-fired. The wooden vat is placed over the kettle, filled with the dried herb, and



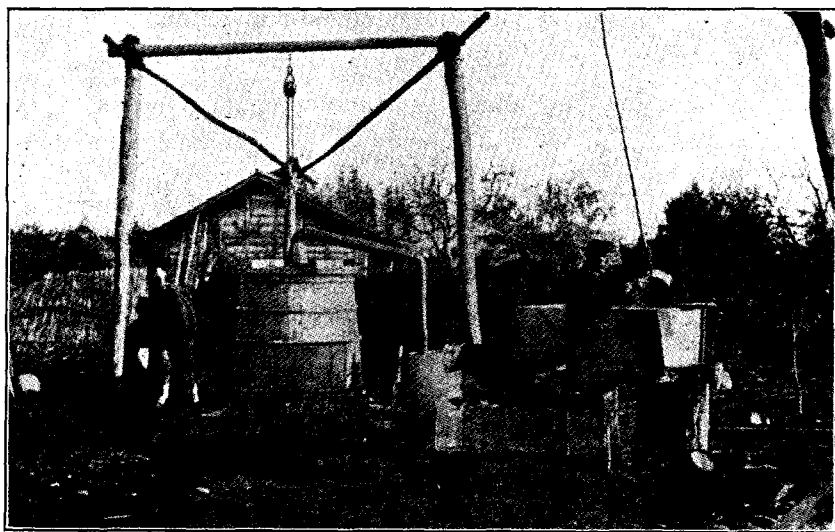
DRYING PEPPERMINT HERB AT NOTSUKESHI FARM

then covered with the condenser filled with water. The steam carries with it the oil, which condenses on the lower surface of the condenser; the mixture of water and oil passes through a rectangular wooden tube (sometimes bamboo split into two) into a receiver called a "Mizukiri-Kame." The capacity of the wooden vat is about 124-166 lbs. of the dried herb, from which a yield of oil amounting to about 1.07-1.6 per cent of the dried herbs is obtained.

(2) By the so-called "Kikaido" still (a wooden vat) and a spiral condenser. This type of still was generally employed at Okayama and Hiroshima prefectures in former days but rarely in Hokkaido. The form of the vat is the same as the above, but after charging, it is tied down by an iron chain fixed in the floor to tighten the joint between wooden vat and kettle so as to prevent as far as possible the escape of steam. Its capacity is about 207 lbs. of the dried herbs. On the upper part of it there is placed a metal pipe, which is connected to a spiral condenser (metal) in a wooden trough filled with water.

(3) By the so-called "Seiro" still (the wooden steaming box). It originated in Hokkaido and is generally employed there, especially in Kitami district. It consists of three or six sets of wooden frames which

are superimposed. The same kind of connecting pipes and condenser referred to already is used. The space of the frame around the rim is packed by strips of moist cloth, rags, wheat flour or rice bran. The Seiro is placed as tightly as possible on a suitable



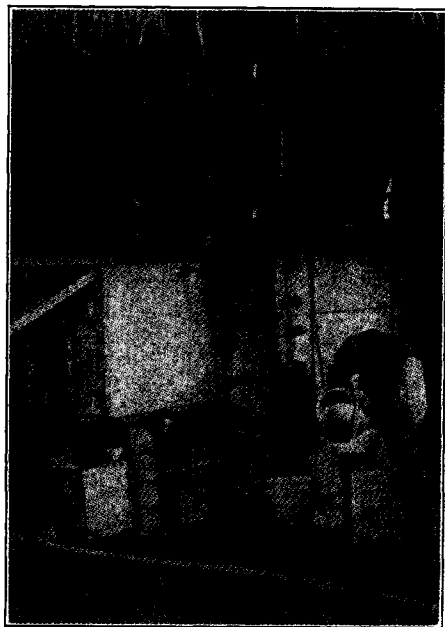
DISTILLING PEPPERMINT OIL BY HANGING VAT-STILL AT NAGAIJAMA VILLAGE IN THE DISTRICT OF KAMI-KAWA (ISHIKARI)

of October to the last of November) in improvised plants close by the drying huts. The distillation of oil is carried out as follows:

(1) By means of a wooden vat-still and the so-called "Tensui-Kama" condenser. The still is the

cast iron kettle filled with water and held down tightly by means of a chain fixed to the ground. It can hold 400-500 lbs. of the dried herbs from which a 1.2-1.6 per cent yield of the oil is obtained.

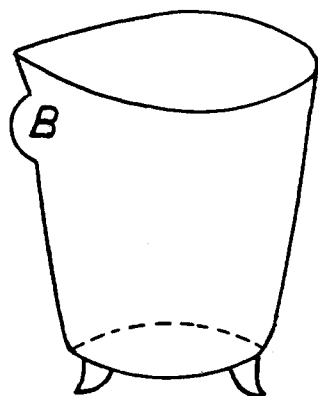
The advantages of the "Seiro" are: the larger charg-



DISTILLING PEPPERMINT OIL BY SEIRO (OLD TYPE OF STILL) AT NOTSUKESHI FARM

ing, less labor for charging and discharging than the still referred to before. On the other hand, it has the following defects: the distillation is incomplete on account of some oil remaining in the "Seiro;" besides, the life of the still is only about four years.

(4) By the hanging vat. The "Seiro" has been lately improved and provided with a false bottom of metal netting, the other parts remaining the same. At the end of the distillation the still (Seiro) is hoisted by means of a rope attached to a series of pulleys and then the distillation residue is discharged. The operation was made easier by the use of this kind of improved still. Such use of the hanging vat is said to have additional advantages; namely, the charge of material is larger, discharging easier and durability prolonged (about ten years). The author thinks that it is the best type of still employed among the distillers of peppermint oil.



RECEIVER "MIZUKIRI-KAME"

As a receiver, the so-called "Mizukiri-Kame" is employed, which is a pot of stoneware with a small opening on the bottom. The pot stands in the beginning of distillation, in a small trough filled with water. As the oil distills and accumulates in the pot, water in the pot is gradually displaced through the opening on the bottom into the trough until finally the entire

pot is filled with oil and then it can be removed by closing the opening with a finger tip while under water. Water in the trough is made to flow back into the kettle from time to time for replenishing it.

As a rule, the end of a distillation is determined by practice from the appearance of the distillate dropping into the receiver. In this way one entire process is carried out in about three hours, charging and discharging requiring each about thirty minutes. Such distillations are usually repeated three or four times per day.

The crude oil is separated from water, filtered and then put into cans. Two cans are packed as one set, in a box. The product is sold to commission merchants or directly to exporters and through those channels it is exported from Yokohama or Kobe. The separation of menthol is carried on in the hands of exporters before the goods are shipped either to Europe or America. The distillation residue is used as forage for domestic animals or is burned in order to save the ash as fertilizer.

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ON JAPANESE PEPPERMINT OIL

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The peppermint oils examined by the author are those which are produced at the Kitami Branch of the Agricultural Experiment Station of Hokkaido and the Odakogetsu Peppermint Oil Trade Association in the Okayama prefecture.

I. HOKKAIDO PEPPERMINT OIL OF ENGLISH AND GERMAN ORIGIN

Peppermint of Mitcham, England and Hamburg, Germany which were imported into Japan a few years ago, have been put on trial cultivation and dis-

	Year	German origin	Japanese origin (Kitami-Akamaru)	English Origin
Plantation.....	1910 1911	Nov. 10 May 12		
Germination.....	1910 1911	May 26 June 1	May 23 May 7	May 25 May 5
Flowering.....	1910 1911	Sept. 4 Sept. 7	May 7 May 7	Sept. 4 Sept. 13
Cutting.....	1910 1911	Sept. 23 Sept. 16	May 7 May 7	Sept. 13 Sept. 13
Length of peppermint at cutting time.....	1910 1911	53.93 cm. 79.08 cm.	88.48 62.42	57.27 66.05
Weight of cutting per 1 ton (0.245 acre).....	1910 1911	421.1 kg. 1716.6 kg.	559.1 1161.2	771.0 1158.3
Weight of dried herb per 1 ton.....	1910 1911	124.13 kg. 399.9 kg.	143.0 199.57	214.88 279.15
Weight of oil from dried herb per 1 ton.....	1910 1911	975 grams 255.0 grams	787.5 1687.5	2625 2775
Yield of oil.....	1910 1911	0.79% 0.63%	0.52 0.84	1.23 0.99