Control against ambient high temperature

In order to protect dairy cows from the effect of heat they must be housed in cooler environment as possible. So, studies on the location and structure of barns keeping cool during high ambient temperature were conducted.

As a result it was revealed that the most important factors were roof structure to keep out the effects of direct rays of the sun and the width of shade to keep out those of their reflection (radiation+reflection). But these factors had their limitation in lowering air temperature during high temperature periods. In order to keep optimum ambient temperature it was necessary to have air conditioning barns and to send cooled air in. Where a supply of cool water is abundant the sending of cooled air is less expensive and therefore feasible. But both of them are generally expensive and in many cases not practicable.

However, according to studies on diurnal and seasonable changes in air temperature, those in body temperature and seasonable change in lactation, etc., if there is a fair spell of low temperature in part of day, body temperaure raised by high air temperature returns to normal. It also disclosed that when a spell of comparatively low temperature or cold nights continued during a high temperature period body temperatre declined to normal and concurrently milk yield approached the expected yield.

Therefore, the above findings showed that even if the effects of high air temperature could not be kept out from cows all through the day the effects of high air temperature could be lessened. Some hours of cold temperature kept artificially in a day, and some spell of cold temperature during a high temperature would cut off continuation of the high body temperature. And they would help to prevent depression in systemic function.

Furthermore it was found that the diurnal change of air temperature during a hot summer had a considerable difference between in doors and outdoors. Grazing immediately after sunset on to night, and hourly regulation of cow's activities are means to control heat in the process of daily management on dairy cattle. Water sprinkling on the animal body is effective in checking increase in body temperature.

References

1) S. Ishii, Bul. of the Kyushu Agr. Experiment Sta., Vol. 9, pp. 399-491. 1964.
2) S. Ishii, Bul. of the Kyushu Agr. Experiment Sta., pp. 114-9. 1962.
3) S. Okamoto et al., Ann. Bul of the Kyushu Agr. Experiment Sta., Vol. 11, pp. 183-243. 1965.
4) S. Okamoto et al., Ann. Bul. of the Kyushu Agr. Experiment Sta., pp. 78-84. 1965.
5) Rhoad, A.O., Trop. Agr. Trin., 21,162-164. 1944.

Edible Rice Bran Oil in Japan

T. AKIYA

Chief, Vegetable Oil Food Laboratory, Food Processing Division,
Food Research Institute,

Introduction

The production of rice bran is estimated to be 1.2 million tons in our country. Rice bran is only a by-product of milling brown rice. However, since rice bran contains about 19% crude oil it is one of good potential oil sources.

Our efforts were concentrated on manufacturing rice bran oil of good quality. To reach our goal several difficulties had to be overcome and quality of our rice bran oil was under

intensive investigation.

This article will describe how to manufacture rice bran oil of good quality and review our researches and investigations.

Manufacture of edible rice bran oil

In order to understand how to manufacture edible rice bran oil, it would be of value to present what problems we had.

Collection of rice bran immediately after milling brown rice is one of the important factors to obtain edible rice bran oil, because rice bran contains lipase and free fatty acids contents in rice bran increase rapidly immediately after milling. Rice bran with great amounts of free fatty acids is not suitable for manufacture of edible rice bran oil. Later mention will be made on how rapidly free fatty acids contents in rice bran increase and how to stop increase of free fatty acids.

Fig. 1. shows flowsheet of manufacture of edible rice bran oil.

The first step is to remove broken rice grains and foreign matters. Broken rice can be removed by passing it through sieves. Magnetic separator is helpful to separate foreign matters.

The second step is adjustment of moisture contents in rice bran. The moisture contents should be reduced to the level of 5%. Several kinds of drier have been developed for this purpose.

The third step is the extraction of crude oil from rice bran. Both batch extraction system and continuous extraction system are used in our country. In both cases hexane is the most popular solvent.

After extraction, solvent is evaporated and crude rice bran oil is obtained. Unlike many other vegetable oils such as soybean oil, rape seed oil and sesame oil, crude rice bran oil contains high amounts of wax esters. To remove wax esters and to obtain triglycerides are one of the important factors to manufacture edible rice bran oil. For this purpose we

Process of extraction and refining

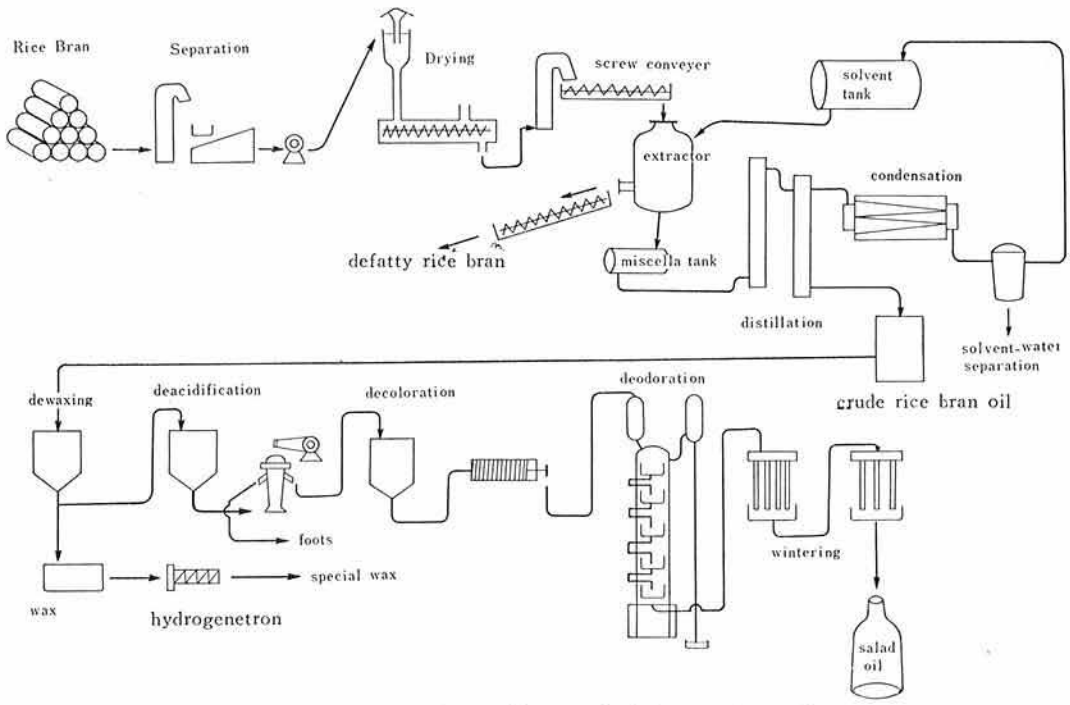

Fig. 1. Flowsheet of manufacture of edible rice bran oil

studied about low temperature crystalization method but industrially our traditional method is still being used.

Even after removal of wax esters, crude rice bran oil contains high amounts of free fatty acids which must be removed. Alkali refining is quite usual to remove free fatty acids. However, according to our finding, acid refining before alkali refining is of great value.

Next step is decoloration. Crude rice bran oil is heated to 60°-80°C and 3-5% active earth is added. Temp erature rises approximately to 120°C. Stirring a while, slurry goes to the filter press and active earth is removed.

The final step is deodorization. In our country Girdler type deodorizer is widely used.

Finally edible rice bran oil is obtained. Sometimes rice bran salad oil is manufacured. Winterization process is required in this case.

The production of edible rice bran oil is increasing year by year. However, in order to reach to the present standard basic researches were required. Our studies will be reviewed as follows:

Review of our studies

How to stop increase of free fatty acids in rice bran

Rice bran supposedly contains lipase which liberates free fatty acids from triglycerides. Free fatty acids contents increase immediately after milling Table 1 shows how fast free fatty acids contents in rice bran increase.[1.]

According to our findings, formation of free fatty acidsstops when moisture contents in rice bran is reduced to less than 3%. However this does not mean lipase is destroyed. When water is added, free fatty acids are again formed in rice bran. The activity of lipase is destroyed when rice bran is heated above 95°C.[2.]

Based on our findings, small pilot apparatus for inhibition of free fatty acids formation was designed and tested. The principle of this apparatus is to destroy lipase just by passing through rice bran in a preheated chamber immediately after milling. The results are shown in Table 2, which shows processing of rice bran with heat is effective.[3.]

Table 1. Increase of free fatty acids contents in rice bran

storage	free fatty acids contents
immediatly after milling	1.9%
4 hours after milling	2.5%
48 hours after milling	4.9%

Table 2. The results of free fatty acids increase in rice bran obtained by heat treatment

storage	No.1	No.2	No.3
0 days	4.5%	5.3%	5.6%
4	5.3	5.1	14.0
8	5.3	6.3	19.9
12	9.6	9.4	28.2
17	7.4	7.7	39.6
24	7.1	8.4	44.7
35	6.6	7.3	47.2
45	7.1	8.9	57.7
55	8.4	7.9	66.7
65	8.8	7.7	84.5
75	10.3	7.9	79.6
85	13.3	17.6	82.3

No.1 and No.2; Samples were heat treated.
No.3; Samples were not treated.

Low temperature crystalyzation of wax esters

To remove wax esters from crude rice bran oil, low temperature crystalization of wax esters was studied. Crude rice bran oil was dissolved into either hexane or aceton and kept at 0°C and soild part formed was filtered. Judging from unsaponifiable matter contents, good results were obtained when three parts of hexane was used for one part of crude rice bran oil and temperature lowered to 0°C.[4.]

Characteristics of edible rice bran oil

Specific gravity, refracive index, acid value, iodine value, saponification value and unsaponifiable matter contents of commercial edible rice bran oil were investigated. The results are summarized in Table 3.[5.]

Major fatty acids composition

The development of gas liquid chromatography makes it possible for us to make the

Table 3. Characteristics of commercial edible rice bran oil.

Sample no.	d_{20}^{20}	n^{20}	AV	I.V.	POV	Unsap.
1	0.9228	1.4720	1.2	107.4	7.6	2.6
2	0.9284	1.4742	1.6	109.8	7.4	3.4
3	0.9237	1.4761	3.2	102.1	6.7	—
4	0.9248	1.4749	1.3	104.7	7.7	—
5	0.9228	1.4764	0.8	101.3	13.3	4.6
6	0.9238	1.4761	1.9	102.7	18.0	4.1
7	0.9227	1.4751	1.9	109.3	11.1	3.7

Talbe 4. Major fatty acids composition in commercial edible rice bran oil.

Sample no.	$C_{16:0}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$
1	22.2	2.3	38.2	35.9	1.4
2	17.1	1.6	43.1	35.8	2.5
3	17.8	3.1	41.9	34.2	2.9
4	19.1	4.0	39.1	35.4	2.5
5	20.0	4.7	39.2	37.1	trace
6	22.5	2.4	30.1	41.3	3.7
7	18.3	2.4	44.7	34.8	trace

quantitative determination of major fatty acids composition. Palmitic, stearic, oleic, linoleic and linolenic acids contents of commercial edible rice bran oil are shown in Table 4.[6.]

Stability of commercial edible rice bran oil

Edible rice bran oil is often used as frying oil and so its heat stability must be good. Active oxygen method was studied and results are shown in Table 5.[7.]

Table 5. Stability of commercial edible rice bran oil.

Sample no.	AOM value	Sample no.	AOM value
1	8.5	5	25.0
2	18.5	6	9.5
3	9.0	7	8.5
4	9.0	8	6.5

Studies on characteristics and nutritive changes of oils during heating

Edible rice bran oil was heated for 12 hours and samples were taken every three hours and characteristics changes were determined. For comparison soybean oil was used. The results are shown in Table 6.[8.]

Table 6. Changes of characteristics during heating

	hrs	d_{15}^{15}	n^{60}	A.V.	I.V.
Rice Bran oil	0	0.9147	1.4778	0.6	99.6
	3	0.9136	1.4780	1.0	98.4
	6	0.9156	1.4781	1.0	98.2
	9	0.9156	1.4782	1.4	97.2
	12	0.9207	1.4783	1.2	97.3
Soybean oil	0	0.9225	1.4783	0.1	121.0
	3	0.9235	1.4783	0.2	120.4
	6	0.9231	1.4785	0.2	120.6
	9	0.9244	1.4788	0.2	119.5
	12	0.9347	1.4793	0.3	119.7

The samples mentioned above were given to the weaning rats and growth rate was checked. The nutritive value of edible rice bran oil was the same as that of soybean oil and better than that of rape seed oil.[9.]

Frying loss of edible rice bran oil

From the practical point of view, frying loss is one of the important factors. A certain amounts of bread, tofu and potato were fried at 180°C in 1400g of oil and frying loss were measured. Edible rice bran oil, soybean oil and sesame oil were tested. The frying loss was the least in case of edible rice bran oil, especially so when bread and potato were fried.[10.]

Table 7. Frying loss of edible rice bran oil.

	Bread	Potato	Tofu
Edible rice bran oil	1.20	0.15	0.43
Soybean oil	1.95	0.15	0.43
Sesame oil	—	0.45	0.44

Components of unsaponifiable matter of rice bran oil

Components of unsaponifiable matter of rice bran oil was examined. From cold ether soluble fractions long chain saturated alcohols having 28C, 30C and 32C were isolated and identified.

After removal of those alcohols, elution chromatography was carried out repeatedly. From hydrocarbon fractions squalene was isolated and identified by converting to hexa-

chloride. From sterol fractions β-sitosterol and ergosterol were separated and identified.

A fairly large amounts of ferulic acid ester was also obtained. Unknown compound having a melting point of 157-158°C was obtained. Lieberman-Burchard reagent gave a blue color. The molecular weight by Rast method was 370. The carbon and hydrogen contents were 83.79% and 11.77%, respectively. However, further studies have been suspended[11].

Conclusion

We have succeeded in manufacturing edible rice bran oil, because we can collect rice bran promptly.

Rice eating habit is not limited to our people. Most Asiatic people like to eat rice. Moreover, in many countries milling scale is larger than ours and it is easy to collect rice bran immediately after milling. There exists potential background for developement of rice bran oil industry with good quality.

This article reviewed our studies on edible rice bran oil.

References

1) Shokuryo, 9, 121 (1966).
2) Unpublished.
3) Shokuryo no Kako to Chozo, 1, 1 (1953).
4) Presented at the annual meeting of Japan Chemical Society, Tokyo. April (1958).
5) Shokuryo, 9, 124 (1966).
6) Shokuryo, 9, 125 (1966).
7) Shokuryo, 9, 125 (1966).
8) Eiyo to Shokuryo, 14, 397 (1962).
9) Eiyo to Shokuryo, 14, 399 (1962).
10) Shokuryo, 9, 126 (1966).
11) Agri. and Biol. Chem., 26, 180 (1962).

Fertility Counter

T. KAWAI

Chief, 3rd Laboratory of Genetics, Division of Genetics, Department of Physiology and Genetics, National Institute of Agricultural Sciences

This apparatus is devised to sort out and count fertile and sterile spikelets. The apparatus is composed of seed sorter. seed liner, counter and indicator (A, B, C and D in Fig. I respectively).

In the sorter (A), air is forced to flow through by suctionpower of a blower (d) as indicated by arrows. Threshed fertile and sterile spikelets (mixed) are thrown into a hopper (a) with a vibration mechnism. Spikelts gradually drop into a lamp-chimney-shape glass tube (b). Two white drop-shape bodies (c, Fig. I and Fig. II-1) are movable in order to adjust rate of air-flow through the gap between drop-shape bodies and the glass tube wall. The amount of flowing air is adjusted by a dumper of the blower (d). Seeds float and dance for a while in expanded part of the glass tube (Fig. II-1), and then fertile spikelets drop down to a tray (e), while sterile spikelets are sucked into left part of the sorter. The left part of the sorter consists of an electric blower (d) and a cyclone system (f). Sterile spikelets sucked into the cyclone, where speed of air-flow is suddenly reduced, drop down in a plastic vial (g).

The seed liner and the seed counter are housed in a box (Fig. I). Seeds or sterile spikelets (separately) are thrown into a hopper (h, Fig. I and Fig. II-2). The seed liner is an inclined V-shaped gutter (i, Fig. II-2) with a vibration mechanism using an electric magnet. Amplitude of the vibration of the gutter can be adjusted by changing voltage of electric current charged to the magnet by a sliding transformer (j, Fig. I). Seeds, fallen into the