FREE FATTY ACID IN COPRA : CORRELATION WITH MOISTURE CONTENT AND APPEARANCE FOR SAMPLES LANDED IN SUVA

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FREE FATTY ACID IN COPRA

Correlation with Moisture Content and Appearance For Samples Landed in Suva

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Summary

The free fatty acid (ffa) and moisture content have been determined for copra samples landed in Suva. The moisture content varied from 5.0 to 8.9 per cent. Some first grade samples were above the stipulated 7.0 per cent limit and one second grade sample was below this limit. The range of ffa values was from 0.3 to 2.0 per cent. The ffa content was found to correlate with the microbiological degradation of the copra. High concentrations of ffa were measured in the surface layers of copra pieces, while the central portion was low in ffa. The ffa content of small copra pieces was greater than that of large pieces. The ffa content of export coconut oil could be decreased by screening and seperation of the small copra pieces with high ffa content prior to milling.

INTRODUCTION

Copra, the dried kernal of the coconut contains 60-70% coconut oil. "Pure" coconut oil is a neutral material not containing any free acid.

Coconut oil obtained from mature coconuts, generally has less than 0.1 per cent free acid expressed as a proportion of the weight of the oil. Green copra, the undried material from freshly opened coconuts contains approximately 50 per cent moisture. The liquid associated with green copra is a nutritious media and the growth of fungi and bacteria is rapid. Enzymes associated with the microbiological growth break down the neutral coconut oil to yield free fatty acids. Associated with the degradation is the production of dark colouration and rancid odours and taste in the coconut oil. All degradation products must be removed from coconut oil which is used in the food industry. Limited amounts may be removed by refining the oil, but excessive amounts of degradation products, especially those which impart colour, odour or taste to oil preclude the oil being used as a food.

Accurate laboratory techniques have been standardized to measure the free fatty acid (ffa) content of coconut oil. Following from this standardization, the ffa content is often used as a major criteria of the quality of coconut oil. In general, a low ffa content

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is associated with a light coloured, pleasant smelling oil, free of any unpleasant odours or tastes. It may be noted that the free fatty acid is not difficult to remove from coconut oil. It is rapidly converted to soap by reaction with sodium hydroxide and removed from the oil in a water layer. In the utilization of coconut oil from the manufacture of soap, a high FFA content may be regarded as a positive but insignificant benefit. The dark colour of coconut oil from poor quality copra is a disadvantage in the manufacture of high quality light coloured soaps. Gums and tars in the coconut oil can also form troublesome deposits in the oil handling equipment. In general, the use of coconut oil from poor quality copra for the manufacture of soaps presents only minor problems. However, the quality of the coconut meal produced as a byproduct to coconut oil is an inferior animal food to that produced from good quality copra.

In his report, which forms the basis of current copra marketing in Fiji, Lord Silsoe devotes a chapter to the question of "Why Make Good Copra" (Silsoe, 1963).

At the time of his report, Fiji had a reputation for poor quality copra. Following implementation of his recommendations, the quality of Fiji copra increased dramatically. This was reflected in the free fatty acid values in coconut oil produced from the copra as shown

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in Table I. Fiji was then able to negotiate premium prices for its coconut oil, for which a penalty level was fixed at 1% ffa. This level was easily met in the late sixties but in recent years millers can only produce premium quality coconut oil with great difficulty. This decrease in quality is not shown in grading figures using the same Silsoe grading formula as for the late sixties. This is discussed in the recent FAO report of the coconut industry in Fiji (FAO, 1980). It is suggested that the increase in grading stations and the method of cutting copra in Fiji may contribute to this situation.

It is difficult to measure the ffa content of copra in the field. Here we report a limited study of the ffa content of randomly selected pieces of commercial copra delivered to the Island Industries Depot in Suva. The experimental technique enabled the ffa content of individual pieces of copra to be determined. This could be correlated with other parameters for the particular sample. Due to the very small sample size as a proportion of each shipment, the results are not necessarily representative of the whole batch of copra.

EXPERIMENTAL

Random pieces of copra were taken from the heap formed after each shipment of copra was unbagged at the depot of Island Industries in

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Suva. These were ground in a food blender. Half the sample was dried in an air oven overnight at 105°C for the determination of the moisture content. Coconut oil was extracted from the remainder of the sample by heating with petroleum spirit (b.p. 60-80°C) in a Soxhlet extractor for several hours. The ffa content of the oil was determined by titration with standard sodium hydroxide solution in a ethanol/ether solvent according to standard techniques (IUPAC, 1979). The ffa content is calculated as lauric acid on a weight/weight basis as is the usual custom for coconut oil. The results are tabulated in Table II.

DISCUSSION

Copra grading in Fiji is based upon a sample of 10 pieces of copra taken from approximately 10 per cent of the sacks. The moisture content is measured by a meter registering the resistance between two prongs inserted into pieces of copra. First grade copra must average less than 7 per cent moisture with 8 per cent being the upper limit for second grade copra. In addition, colour, cleanliness condition and smell are assessed on a five point scale (4 to 0). First grade copra must receive at least 9 marks and second grade at least 4 marks out of 16.

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From the results shown in Table II, the moisture content varied from 5.6 to 8.9 per cent. The highest moisture content was from a sample graded as first grade. For this study, no attempt was made to obtain samples representative of each consignment of copra. Random samples were taken from the top of the pile as poured from the sacks. Samples from only two of the seven consignments are c arly ess than 7 per cent moisture. Sample G had the lowest moisture content at 5 per cent, but

same pieces of copra, so sample variation cannot explain this difference. The physical appearance of these two samples was similar. Sample G was from Rotuma and possibly may have been subject to longer storage than Sample C from Koro Island due to the limited shipping from Rotuma.

The highest ffa content of 2 per cent was from a sample of second grade copra. The moisture content of this copra was less than that from three of the consignments graded as first grade. The ffa content of the copra from the other consignment of second grade copra at 1.1 per cent was not distinctly above the average ffa content of the first grade copra. Two trends emerge from Table II. High ffa content is associated with small pieces of copra showing extensive bacterial or fungal growth. This is shown to a limited extend in samples G1 and G2 from the same consignment, where smaller pieces were selected for G2.

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From the 1 kilogram sample of copra forming sample F, pieces of copra were chosen to represent the best and worst of the samples on appearance. The "best" samples were small pieces showing no fungal growth whereas the "worst" samples were large pieces completely covered in fungal growth. Moisture and ffa content of these samples is shown in Table III. Surprisingly, the ffa content of the small samples without fungal growth is considerably greater than the large pieces covered in fungus. The surface of the small pieces was pitted due to bacterial decomposition. It appears that the ffa content is associated with decomposition on the surface of the copra. This was confirmed when the surface was cut from a large piece of copra covered in fungal growth from assignment F. As shown in Table III, an unsectioned portion of this piece yielded an ffa of 1.5 per cent. The outer surface contained 2.4 per cent ffa, whereas middle of the copra contained only 0.2 per cent ffa. Further evidence for extensive decomposition on the surface of copra is seen in results from small copra chips, obtained by passing the copra over a screen at the mill. Based on appearance, these chips would be graded as first grade. However, the ffa content was very high at 14 per cent.

CONCLUSIONS

The results of this study would suggest that the ffa content of coconut oil produced in Fiji could be decreased by placing a higher grading

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penalty on copra showing bacterial or fungal decomposition and containing a high proportion of small pieces, If this could be done on a consistent basis, the requirement for absolute moisture determination may not be necessary, as the growth of the micro-organisms is largely a function of the moisture content. These conclusions are consistent with the recommendations of the FAO report (FAO, 1980), where initial drying of copra in a half shell is suggested and attention is drawn to the high grade copra produced in Tonga by inspection grading. This study is currently being extended to the effect of drying in the half shell upon drying time and ffa content. These results will be reported subsequently.

It is also suggested that the ffa content of export coconut oil could be significantly reduced by screening all received copra so as to separate approximately 10 per cent of the copra as smaller pieces. These smaller pieces could be milled separately from the bulk of the copra to yield a grade of oil which could be readily utilized for the manufacture of soap or as a possible fuel for diesel engines (Solly, 1980).

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9. TABLE I

Annual Copra Grading and Free Fatty Acid Content*

Year	1st Grade per cent	2nd Grade per cent	ffa per cent
1964	no grading	no grading	1.6
1965	no grading	no grading	1.7
1966	45	38	0.9
1967	68	28	0.8
1968	81	17	0.6
	86	13	0.6
1976	76	24	1.0
1977	84	16	1.0
1978	83	17	1.0

* FAO, 1980

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TABLE II

Moisture and Free Acid Content

ple	Grade	Size of Pieces	Fungal growth	Smell	Colour	% Moisture	% fa (Average
	I	medium to small	green fungus on 10%	slightly musty	Reddish white	7.0	0.8
	II	Average to medium	green fungus on 70%	very musty	white to dark brown	7.6	
	I	Average to medium size	None	slightly musty	light brown to dark reddish brown	5.6	0.3
	II	Small	On 80% but very little green fungus	very musty	white to mottled brown	6.7	2.0
	I	Copra cut into half inch fingers	Brown spots on 10%	slightly musty	white to light brown	7.5	1.0
		medium	green fungus on 95%	Very musty	light brown to reddish brown	8.9	1.4
	I	medium	none	sweet	white to light brown	5.0	0.7
	I	small	none	sweet	white to light brown	4.8	0.9
pping	reject	very small about 1cm^2	none	sweet	light brown to dark brown	9.1	14.3

TABLE III

Seclected Portions Free Fatty Acid Content

Copra Sample	Portion	*Fungal Growth	Colour	% Moisture	% ffa
F	whole piece	covering surface	readish brown	9.1	1.5
F	outer layers	covering top surface.	reddish brown surface	17.6	2.4
F	middle layer	none apparent	white white	8.4	0.2
F	"best piece"	none apparent	reddish brown reddish brown	8.3	1.7
F	"worst piece"	covering surface	reddish brown	8.4	0.9

*includes moisture in fungal growth.