IMPROVING THE SMALL SCALE EXTRACTION OF COCONUT OIL

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SUPPLEMENTARY REPORT ON AQUEOUS PROCESS OF COCONUT OIL EXTRACTION

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FURTHER RESEARCH ACTIVITIES IN THE AQUEOUS PROCESS

1. Introduction

Initial research results obtained during experimental and field trials of the aqueous process were not conclusive and complete enough to merit its useful dissemination to local coconut oil processors in the rural areas of Ghana.

Accordingly, during a mid-term evaluation meeting in Abidjan, the need for further research work was therefore recommended by TCC, to allow a complete achievement of results that would strengthen results already obtained, and could be successfully transferred to the rural women.

A proposal to this effect, submitted by TCC to CFC through NRI was approved and funding made available in February 1997.

2. Objective

The main aim of the research was to carry out further investigations into the aqueous process with the objective of improving the traditional washing, creaming, skimming and boiling operations.

3. Methodology

To be able to achieve the above objective, TCC attempted to develop the following equipment for laboratory trials to assess their technical viability.

The equipment included:

i. Coconut milk extraction machine to replace manual washing (kneading) of grated fresh kernels for milk extraction. This was aimed at reducing operation time, and increasing efficiency.

ii. Creamer/centrifuge to replace the traditional 12 hour overnight creaming in oil drums, to reduce creaming time, and increase both creaming and skimming efficiencies.

iii. Improved oven/hearth to replace traditional 3-stone hearth to reduce boiling time, save wood fuel, and avoid excessive exposure of the processors to heat and fire.

Trials with the milk extractor and improved hearth were alongside similar trials using traditional extracting milk and boiling of cream to allow a better comparative analysis of the two methods.

4. Trials

4.1 Milk Extractor

Working jointly with SIS Engineering Limited, Kumasi (a client of TCC) a prototype washing machine for coconut milk extraction was constructed, and installed at the TCC Food-Processing Unit for test runs.

The prototype machine consisted of a galvanised cylindrical drum of 60 cm diameter, and 60cm high sitting on a conical base of 30cm high, welded onto a 3-legged basin. Inside the drum is a shaft with blades which turn at about 50 rpm when the machine is in operation, and thus agitate the gratings during the washing operation. The machine is run on a 5HP electric motor.

Three (3) test runs were performed with the machine. The trials were repeated, using traditional washing methods carried out by a woman coconut oil processor from Nzema.

4.1 Kneader/Washer

Working jointly with SIS Engineering Limited, Kumasi (a client of TCC) a prototype washing machine for coconut milk extraction was constructed, and installed at the TCC Food Processing Unit for test runs. Four (4) test runs were performed with the

obtained for all the three trials for the traditional processing. Average washing rate (1.23kg/min) for the traditional hand washing was only 8% higher than the average rate (1.33 kg/min) for machine washing.

To further improve upon the machine it was sent back to the TCC engineering workshop for the necessary modifications.

5. Modified Milk Extractor

In the modified machine, the agitator shaft was replace with a propelling shaft which is surrounded by a metal cage. When the machine is in operation, the shaft pick up gratings from the bottom of the conical base and forces the gratings through the holes of the cage.

5.1 Further Trials with Modified Machine

Three production trials in batches of 200, 300 and 300 were made with the modified machine.

TCC Food Processing Unit for test runs. Four (4) test runs were performed with the machine. The trials were repeated, using traditional washing methods carried out by a woman coconut oil processor from Nzema.

Summary of results are as Shown in Table 1

Table 1

	TRADITIONAL				MACHINE		
No. of Coconuts	200	200	100	200	200	200	100
Wt. of gratings processed (kg)	46.6	46.6	24.9	51.3	48.3	57.8	20.4
Washing time (min)	45	40	25	30	35	30	30
Moisture content of gratings (%)	46.3	41.1	41.5	45.0	47.6	43.8	43.6
Dry weight in gratings (kg)	24.9	27.5	14.6	28.2	25.3	32.5	11.5
Oil content of grating (%)	71.2	71.2	72.1	72.4	70.9	70.6	71.6
Wt. of oil in grating (kg)	17.8	19.5	10.5	20.4	17.9	22.9	8.2
Wt. of cream (kg)	24.5	24.4	14.1	29.4	27.4	25.6	12.7
Wt. of oil extracted (kg)	10.7	12.9	6.1	11.8	9.8	13.4	4.6
Wt. of oil in aqueous residue (kg)	3.9	4.0	2.5	5.1	4.0	5.8	1.9
Oil washed from grating (%)	78.0	79.5	76.5	75.0	77.6	74.7	76.6
Extraction Efficiency (%)	60.3	66.1	58.1	57.8	54.7	58.5	56.1

Comments and Conclusion

It is clear that the average % oil washed for the 4 traditional washings (77.3%) was only 1% more than the average of 3 machine washings (76.3%) indicating that hand washing was a little more efficient. This explains the higher oil extraction efficiencies

Not very convinced about the skills of the woman who assisted in the first trials, the leader of the Nsein Women's group (Anti Bella) was brought to Kumasi to assist the 2nd trials.

In the first set of two trials, Anti Bella was asked to use the traditional aqueous process to produce oil in two batches of 200 and 300 coconuts.

In the 200 coconut batch, the gratings were divided into 3 portions and each portion washed in a basket, while the gratings were divided into 5 portions in the 300 batch. Two washings were made in each batch - that is, after the first washing, the spent fibres were milled and washed again.

The 2nd set of 3 trials in batches of 200, 300 and 300 coconuts involved the use of the modified machine for milk extraction, and the improved oven for cream boiling. In both the 200 and first 300 batches, gratings were divided into 2 portions and 2 washings made. In the last 300 batch, gratings were divided into 3 portions and 2 washings made.

5.2 FINDINGS

Findings of the trials are presented in Table 2

Table 2

	Traditional		Improved		
No. of coconuts	200	300	200	300	300
Wt. of gratings processed (kg)	64.6	90.3	59.3	43.3	43.3
Moisture Content of gratings %	44.2	44.6	43.4	43.3	43.3
Oil Content %	71.4	72.2	72.6	71.8	70.7
Washing time (Mins)	75	140	67	144	110.0
% Oil washed	78.6	79.5	87.2	77.6	83.6
Cream Obtained (Kg)	29.6	47.4	29.7	47.9	48.2
Oil Obtained (Kg.)	13.9	20.9	13.4	19.6	19.9
Oil Extractor Efficiency	54.1	56.0	54.8	53.7	58.4

5.3 Comments and Conclusion

It is very clear that the results obtained with the modified machine are quite encouraging. In the 2nd 300 batch trial, oil extraction efficiency increased by 2.4% over the traditional process. % Oil washed was also 4.1% higher than the 300 batch traditional washing. However, the overall average washing rate for traditional washing (0.76 kg/min) is 1.3% higher than the overall average machine rate (0.75 kg/min). It is hoped that given a little more time for trials, the performance of the

modified machine in time and washing rate could be further improved above the traditional washing.

6.0 Creamer/Centrifuge

Attempt was made by the Centre to produce a manual creamer based on an imported creamer (separator) used by the University's Animal Husbandry Department to cream milk for the production of yogurt.

Test run of the creamer using 2 litres of coconut milk produced 209 gms of cream in 5 mins. This gave 140gms of oil when processed. Base on this successful trial TCC decided to produce a prototype of the creamer at its engineering workshop.

The first prototype was produced and tested in early June but no cream was produced. It was later found that the speed of the machine (4500rpm) was rather too low, when the speed of the imported creamer was measured and found to be 9000rpm.

Attempts are being made at the workshop to get the prototype to run at 9000rpm for further testing.

7.0 Improved Oven/Hearth

There is no doubt about the fact that the traditional 3-stone hearth used for boiling cream produces a lot or unprotected smoke and heat which present a serious health hazards to the processors. In its effort to solve this problem TCC constructed an improved hearth for testing. The hearth which was made of burnt bricks is provided with a chimney which direct smoke away and provides good draught for efficient burning. The thick walled brickworks prevent heat losses by conduction and radiation. An outstanding feature of the hearth is a larger aluminium locally cast aluminium bowl boiling pan which is permanently fitted into the brickwork. A sliding door which opens into the fireplace can be used to control the flow of air (oxygen) into the fireplace to control the intensity of fire.

Initial results of few trials on cream boiling using the improved hearth, and traditional hearth are presented in Table 3.

Table 3: Results of Testing of Improved Hearth

	Traditional 1	Traditional 2	Improved 1	Improved 2
No. of Coconuts	100	50	100	50
Wt. of cream kg	13.65	5.6	10.5	6.2
Time	125	55	65 mins	45 mins
Shells (Kg)	12.3	6.6	9.6	4.4

7.1 Further Trials

Three more trials were made after the first set of 2 trials. The improved hearth was used to boil cream from 200, 300, 300 coconut batch production.

Cream from two 200 and 300 coconut batches were also boiled using the traditional 3-stone hearth.

7.2 Findings

Results obtained are presented in Table 4

	Traditional 3-Stone hearth		Improved Hearth		
No. of Coconuts processed	200	300	200	300	300
Weight of cream boiled (Kg)	29.65	47.4	29.7	47.9	48.2
Boiling Time (Minutes)	110	23.7	15.8	273	32.5
Coconut Shells Used (Kg)	20.7	39.8	18.7	27.7	25
Savings on fuel (Shell) kg	-	-	2.05	12.1	14.8

7.3 Comments

It is seen that while the improved hearth takes longer time in boiling, there is a lot of savings in fuel (shell) used in the boiling, e specially for the 300 coconut batches. The increased boiling time in the use of the improved hearth can be attributed to the small fireplace allowed in the hearth. This does not allow permit enough shells for initial firing of hearth for quick heating. It therefore takes a longer time to heat up, but once heated, the boiling is faster.

8. Conclusion

At any rate, the progress made on the new development is very encouraging, given the limited time for the development work. Further trials will continue to improve washing time for milk extracting machine, while enough space will be allowed in the fireplace of future hearth constructed to reduce initial heating time.

It is also hoped that by the time of the national workshop in Ghana in November 1997, the Creamer would have been developed to a stage where it could be transferred.