

THREE IMPROVED METHODS FOR COCONUT OIL EXTRACTION

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Abstract

Three methods for coconut oil extraction using acetic acid, baker's yeast, and mixed enzymes were investigated. Coconut milk was allowed to settle for two hours; for cream separation. When the cream reacted with 25 % acetic acid at 0.1 % - 0.4 % levels or baker's yeast at 0.5 - 2 g levels for 10 - 14 hours, the oil was separated into two phases; the upper phase containing coconut oil-rich fraction and the lower phase consisting of water. The oil phase was finally boiled for 20 minutes to remove moisture. The other extraction method was based on the combined action of cellulase, α -amylase, protease, and poly-galacturonase at 0.1 % to 1 % on grated coconut meat at pH 4 to 8, 40°C to 60°C for 30 minutes. Oil recovery, moisture content, FFA, peroxide value, saponification value, anisidine value, iodine value and colour of the oil were studied. Up to 60 % recovery of high quality oil was obtained by acetic acid or baker's yeast treatment whilst that of mixed enzymes treatment was 73 %. These three alternatives wet processing showed significant improvement as compared to the traditional process.

INTRODUCTION

Coconut oil constitutes a little over 10 % of the total oils and fats entering the world market. There were indications that the demand of coconut oil in domestic and international markets was in the increase and the trend was likely to be maintained (Thampan, 1984).

There are several techniques for removing oil from coconut meat as well as from copra, such as wet process, dry process, and solvent extraction process. Even though the more efficient and modern processes for coconut oil extraction are available, at present the processing of fresh coconut meat into oil in the traditional way or wet process is still practised at village level. Traditional wet process for obtaining the oil is by grating coconut meat and separating the oil from the extracted milk by cooking. The process is still practised in Malaysia, Indonesia, Thailand, and many other coconut producing countries (Thieme, 1968). There are slight process variations in various countries which result in oil of variable quantities and qualities. Generally, the oil recovered by traditional wet process is considerably low between 30 - 40 % (Thieme, 1968). Moreover the quality of the oil is also poor due to the high moisture content, and the shelf-life is short. This process is also time and energy consuming (Loo, 1982). However, the traditional process is easy to handle, the oil has a pleasant aroma and the free fatty acid content is low.

In this study therefore, three alternative extraction processes using acetic acid, baker's yeast, and mixed enzymes in liquid form were investigated. The objectives of the present study are (1) to investigate the effect of acetic acid and baker's yeast on the destabilisation of the cream from coconut milk, (2) to investigate the effect of mixed enzymes and pH on the coconut oil recovery, and (3) to study the quantity and quality of the oil extracted.

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MATERIALS AND METHODS

Materials

Fresh grated coconut meat was obtained from a local supplier at Taman Sri Serdang. Acetic acid, Baker's yeast and other analytical grade chemicals were obtained from BDH Chemical Inc. Poole - England, while Cellulase, α -Amylase, Protease, and Polygalacturonase were donated by NOVO Industri S.A., based in Kuala Lumpur.

Methods

Extraction procedure

The extraction of coconut milk for acetic acid and baker's yeast treatments were carried out according to Figure 1. 500 g of grated coconut meat was mixed with 1 L of hot water at 70°C. The mixture was kneaded by hands for 5 minutes and the milk was extracted by squeezing and straining. This procedure was repeated three times and the milk obtained were mixed in a beaker. The milk was allowed to stand for two hours to facilitate cream separation. After standing for 2 hours, the coconut milk was separated into two layers. The lower layer which comprised mainly water was drained off by siphoning using small plastic pipe, while the upper cream layer was treated with 25 % acetic acid at 0.1 %, 0.2 %, 0.3 %, and 0.4 % levels or baker's yeast at 0.5, 1, 1.5, and 2 g levels. The mixture was allowed to react for 10, 11, 12, 13, and 14 hours. After the reaction, the cream was separated into two layers again; the upper layer was oil-rich cream layer, while the lower layer being water. The water was drained off and the cream thus obtained was boiled at 102°C for 20 minutes to evaporate the moisture. The boiling time is about 10 times less than the traditional wet process of 3-4 hours.

The oil and its cake were left to cool. Finally the oil was obtained by straining through a layer of fine cheese cloth. The oil was kept in a sealed bottle for further analysis. The extraction procedures for coconut oil extraction using mixed enzymes is shown in figure 2.

150 g of grated coconut meat was mixed with 150 g of water, kneaded for 5 minutes, squeezed, and strained. Coconut milk obtained was heated at 90°C for 30 minute and the cake obtained mixed with water, blended for 1 minutes, and mixed with enzymes of cellulase, α -amylase, protease, and polygalacturonase then placed in a waterbath and incubated at pH 4, 5, 6, 7, and 8 for 30 minutes at 40, 50, and 60°C. After incubation the mixture was strained, the filtrate was mixed with the first coconut milk and allowed to settle for 1 hour. After 1 hour, the mixture was separated into two layers; the upper layer was the coconut oil-rich fraction or cream, while the lower layer was water. The cream layer was centrifuge at 12°C for 30 minutes. Moisture was drained off and the second cream layer was again centrifuged for 30 minutes at 12°C. The water was removed and the oil was left to melt. After melting the coconut oil obtained was strained to separate the residue. Finally the oil was put into sealed bottle for further analysis.

Analysis of Oil quality

The analysis carried out on the oil extracted included moisture content, free fatty acid (FFA) content, saponification value, peroxide value, anisidine value, iodine value, and colour. Moisture and FFA contents were measured according to A.O.A.C. method (1980). Saponification value, peroxide value, and iodine value were measured according to British Standard No. 684 (1976). Anisidine value was measured according to PORIM (tentative) method (1985). Colour was measured by Lovibond Tintometer model E, (British Standard No. 684, 1976).

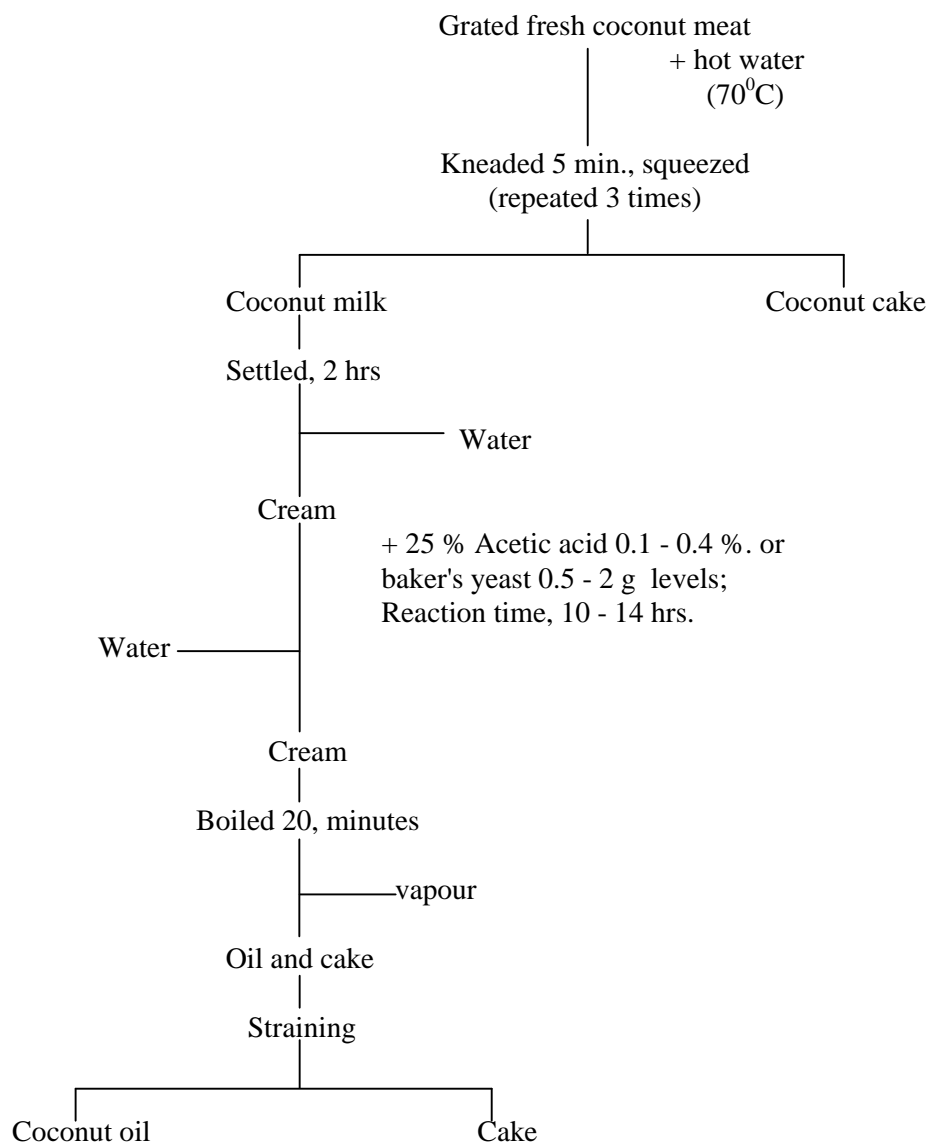


Figure 1 : Extraction of Coconut Oil using acetic acid or baker's yeast.

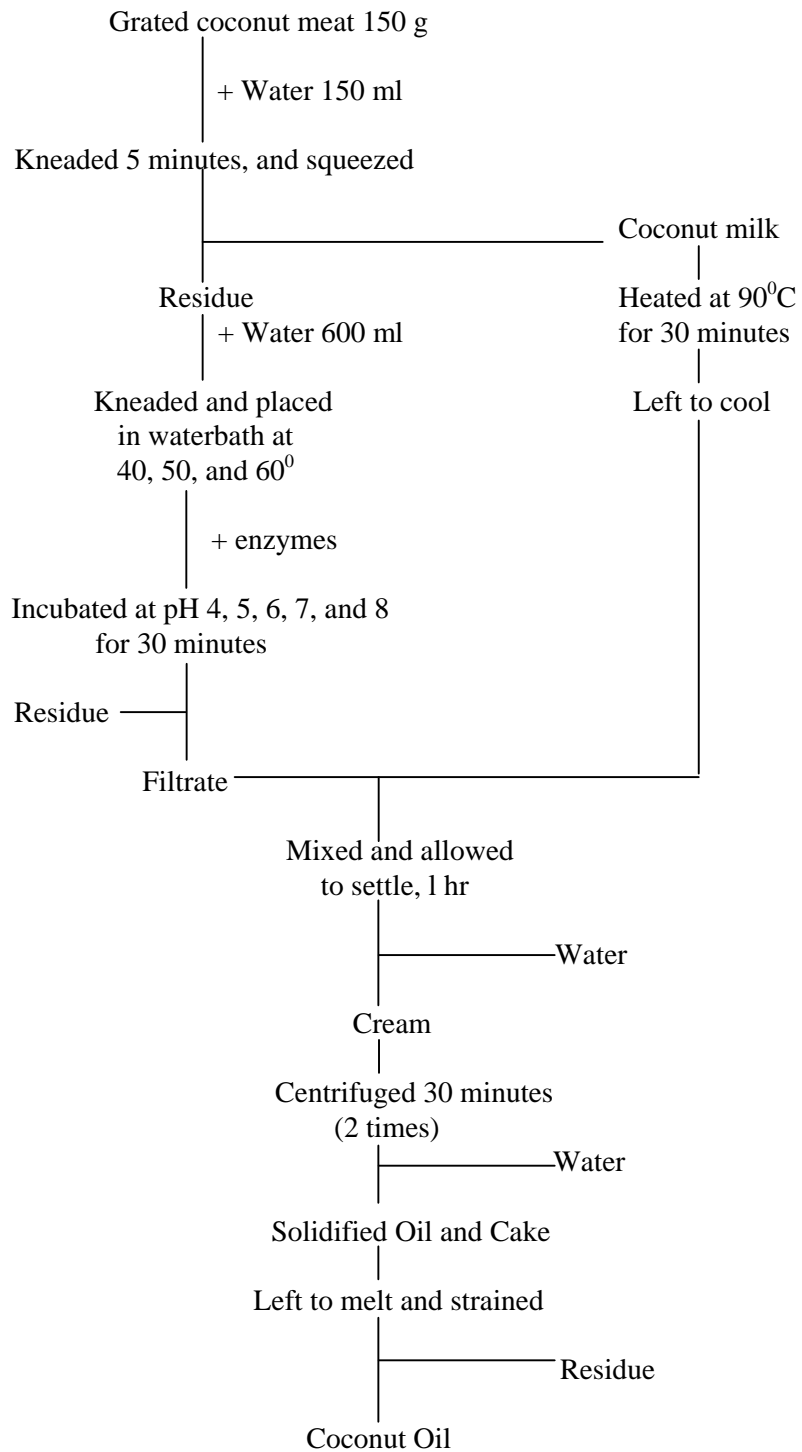


Figure 2 Extraction of Coconut Oil using mixed enzymes.

Oilrecovery

The oil recovery was calculated based on initial coconut oil content and the weight of oil obtained after extraction.

Statistical Analysis

The data were analysed using ANOVA technique. Means that showed significant difference at 5% level of probability ($P < 0.05$) were further separated by Duncan's multiple range test (Little and Hill, 1978).

RESULTS AND DISCUSSION

Oil Recovery

The oil obtained at various acid and yeast levels and reaction time are presented in Figures 3 and 4, whilst that of mixed enzymes in Figure 5. The amount of the oil obtained from acetic acid treatment ranged from 58.25 to 61.02 %, baker's yeast from 60.92 to 62.31 %, and mixed enzymes from 53.26 to 73.8 %. There was no significant difference in oil recovery within and among the treatments of acetic acid and baker's yeast treatments, but there was significant difference ($P < 0.05$) within enzymes treatments. From pH 4 to pH 8, and temperature 40^o to 60^oC there was a significant increase in oil recovery. This was due to the more favourable condition for enzymes activity (Whitaker, 1972). Compared to the oil recovery from traditional wet processing which range between 30 to 40 %, and from the Royal Tropical Institute of Amsterdam, which obtained 50 % (Loo, 1982), oil recovery using the three methods used in this study showed a significant improvement.

Oil quality

From Figure 6 to 12 the quality of oil extracted it can be summarized as follows :

1. Acetic acid treatment:

Moisture content ranged from 0.13 to 0.20 %; FFA, 0.035 to 0.062 %; peroxide value, 0.16 to 0.20%; anisidine value, 0.027 to 0.030; iodine value, 8.08 to 8.6; saponification value, 260 to 262; The colour of the oil was unchanged at 0.7.

2. Baker's yeast:

Moisture content Tanged from 0.112 to 0.204, FFA, 0.043 to 0.052 %, Peroxide value, 0.16 to 0.19, Anisidine value, 0.0266 to 0.0282, Saponification value 259.67 to 260.67, Iodine value, 8.23 to 8.37, and the colour was unchanged at 0.7.

3. Mixed Enzymes treatment:

Moisture, 0.109 \pm 0.003, FFA, 0.051 \pm 0.004, Peroxide value, 0.016 \pm 0.001, Anisidine value 0.026 \pm 0.001, Iodine value 8.36 \pm 0.06, Saponification value, 261 \pm 2.35 and colour was unchanged at 0.6.

The quality of the oil extracted by the traditional method is also included for comparison. There is no international standard for coconut oil, but Asian and Pacific Coconut Community (A.P.C.C.) has proposed one as shown in Figures 6 - 12 (Thampan, 1984). On comparison to the quality characteristics of the proposed standard, it can be seen that the quality of the oil extracted by

acid, yeast, and mixed enzymes treatments can satisfy the requirement for grade I (RBDO) even without further purification, except for the moisture content. Moisture is one of the most important parameters for oil quality because the moisture together with FFA can cause oxidation in the presence of light. Therefore, by removing the excess moisture in the extracted oil, it would be possible to completely meet the proposed international standard. The oil could also satisfy the Indonesian Standard for frying oil (RBDO) [moisture content of the oil is 0.25 %, iodine value range from 7.9 to 9.5, saponification value range from 255 to 265, and the colour is normal (Standard Industri Indonesia, 1977)]. The quality of the oil extracted is therefore higher than that obtained from traditional wet processing.

CONCLUSION

From this study it can be concluded that this three alternative methods for extracting coconut oil using acetic acid, baker's yeast, and mixed enzymes could improve the quantity and quality of the oil obtained as compared to the wet traditional processing method.

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ACKNOWLEDGEMENT

The first author would like to thank the Universiti Pertanian Malaysia and the National Agricultural Extension Project III Ministry of Agriculture of the Republic of Indonesia for providing research funding and scholarship, respectively. Appreciation is also extended to the Director, Rehabilitation and Expansion of Estate Crops, Directorate General of Estates, Ministry of Agriculture for his approval to publish this paper.