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Research Article

Comparision of physical and chemical characteristics between inoculum and conventional processes for toddy palm cake

Unnop Tassanaudom[1]* Wannapa Srapinkornburee[1] Suriyaporn Nipornram[1] and Wassana Chatdumrong[2]

[1]Department of Agro-Industry, Faculty of Science and Agricultural Technology, Rajamangala University of Technology Lanna, Phitsanuloke 65000 Thailand.

[2]Department of Microbiology and Parasitology, Faculty of Medical Science, Naresuan University, Phitsanuloke 65000 Thailand.

*Author to whom correspondence should be addressed, email: unnop_tas@hotmail.com

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Abstract

The objectives of this research were to produce toddy palm cake inoculum and to investigate the physical characteristics and chemical composition of toddy palm cake produced by the inoculum process and the conventional process. The inoculum process was developed to produce toddy palm cake for out of season consumption. The experiments undertaken were to firstly produce toddy palm cake inoculum with initial microbial culture from toddy palm flesh with substituted rice flour at 20, 40, 60, 80 and 100% of toddy palm flesh (w/w). Secondly, was the production of toddy palm cake from the best formula by using all treatments of toddy palm cake inoculum developed from the first experiments. Finally, an investigation was undertaken of the physical characteristics, chemical composition and organoleptic properties of toddy palm cake produced from both the inoculum process and conventional process. The results showed that substituted rice flour at 60% toddy palm flesh was appropriate for inoculum production. However, the physical characteristics and organoleptic properties of toddy palm cakes that were produced from the inoculum with substituted 80 and 100% toddy palm flesh were better than inoculum with substituted 60% toddy palm flesh. Additionally, it was found that all toddy palm cakes produced by the inoculum process required food dyes for colour improvement. The sensory evaluation by untrained panelists of toddy palm cake produced by the inoculum process and toddy palm cake produced by the conventional process were significantly different ($p<0.05$) in all attributes.

Keywords: *Borassus flabellifer*, deserts, sweets, yeast, fermentation, Thailand.

Introduction

Toddy palm cake is a one of the more popular Thai desserts made by mixing rice flour with toddy palm flesh, sugar and coconut milk. The ingredients are fermented and steamed [1]. Varieties type of native flora yeast in toddy palm flesh can produce CO_2 which will cause fermentation and make the palm cake leaven, soft and spongy [2]. However, insufficient yeast in toddy palm flesh is a problem often encountered in toddy palm cake production [1]. In each batch production, the conventional process of toddy palm cake production cannot produce a homogeneous product and quality control including pathogen contamination and food intoxication becomes difficult [3]. In more recent times, the use of inoculums in food fermentation processes has become more popular, such as used in *Kanom Tuay Fu* (Thai dessert) production improvement. When compared with conventional methods, it was found that the addition of a yeast inoculum can improve the texture of *Kanom Tuay Fu*, having high leaven and soft texture [4]. In addition, fermentation time and duration of steaming time have effects on the quality of toddy palm cake and consumer acceptance [5]. From previous work, it was found that toddy palm cake made from toddy palm powder was not significantly different when compared with cakes made from toddy palm flesh [6]. However, the price of toddy palm powder is higher than palm flesh. The aims of this research were to produce toddy palm cake inoculum for use in cake production and to investigate the physical characteristics and chemical composition of toddy palm cake produced by both the inoculum process and conventional process.

Research Methodology

Production of toddy palm cake inoculum

After cultivating microbial starter from toddy palm flesh (harvested locally in Phitsanuloke) with MEB(Merck) for 24hrs [7], the starter was used to produce toddy palm cake inoculum by combining with substituted rice flour (from local market in Phitsanuloke) at ratios of 20, 40, 60, 80 and 100% toddy palm flesh (w/w ; T3, T4, T5, T6 and T7 respectively). The control treatment (T1) had no toddy palm flesh and T2 was the fermented sticky rice inoculum that is generally used in fermented sticky rice products in Phitsanuloke. The inoculum process is shown in Fig. 1.

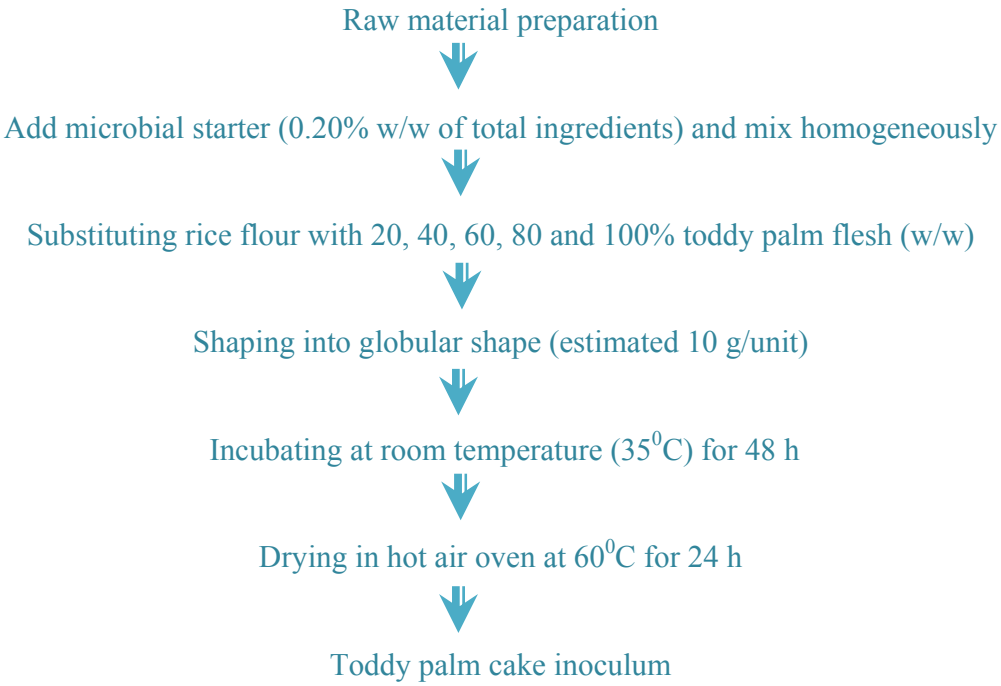

Figure 1. The process of toddy palm cake inoculum production (adapted from Rojanapaiboon [2]).

Production of toddy palm cake with the addition of inoculum

For this study, the toddy palm cake recipe of Rojanapaiboon [2] was modified and used as the reference formula. The total ingredients (345g) consisted of rice flour, toddy palm flesh**,** concentrated coconut milk, sugar, salt, baking powder and water (26.14, 9.82, 28.14, 17.58, 0.20, 0.53 and 17.59% respectively). Toddy palm flesh was then substituted (9.82%) with toddy palm cake inoculum (T1-T7) in the production formula (Fig. 2). Finally, all of the produced cakes were evaluated by hedonic test. The three highest scoring cake samples were then selected for use in the next phase for comparison with conventional toddy palm cake.

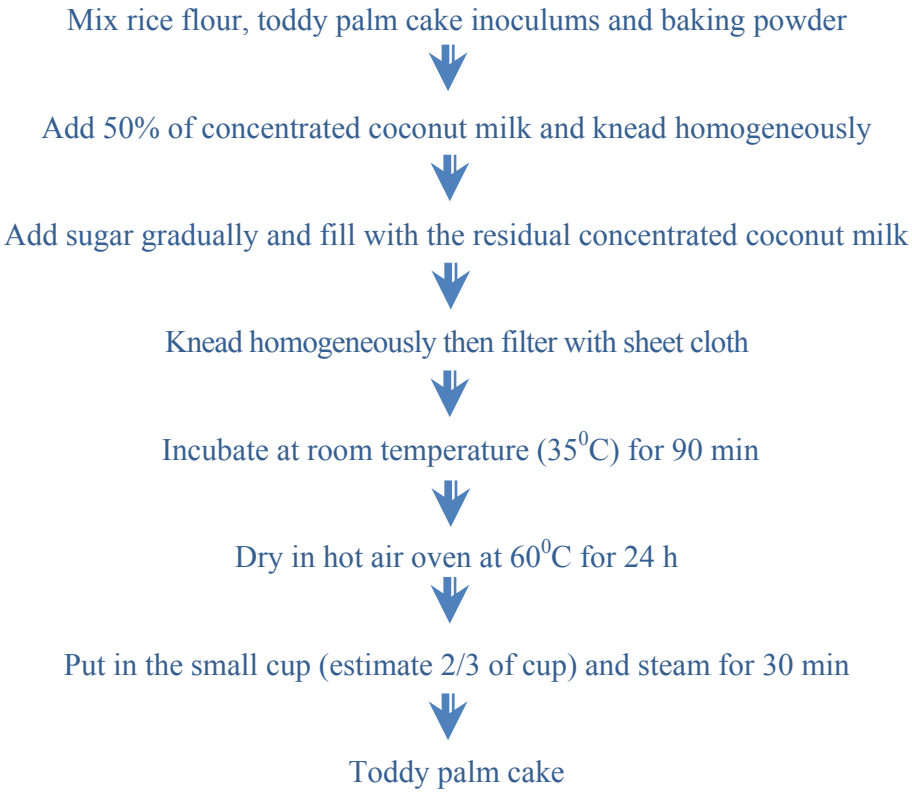

Figure 2. The process of toddy palm cake production (adapted from Rojanapaiboon [2]).

Physical and chemical characteristics

Colours of the samples were examined by using Hunter Lab (Colorflex®: Hunter Lab Colorflex 4510, Hunter Association Laboratory, Inc. USA) in L*, a* and b* values where L represents lightness, a (+) represents redness, a (-) represents greenness, b (+) represents yellowness and b (-) represents blueness. Toddy palm cake textures (hardness and springiness) were determined by texture analyzer (TA.XT. plus, Chapa Techcenter, Stable Micro Systems Ltd. England). Moisture and ash contents were determined by AOAC method [8]. Acidity was determined by pH meter (Hach : EC 30, Germany). Total soluble solids (TSS) were measured by using a hand refractometer (N.O.W. Tokyo, Japan). Protein analysis was performed by Kjeldahl's method (Gerhardt, Germany). Crude fibre was determined by crude fibre analyzer (CWF 1100 : Carbolity, England) and crude fat was determined by Soxhlet apparatus (306/SE-3M : Gerhardt, Germany).

Sensory evaluation of toddy palm cake

The experimental design used in this study was randomized complete block design. Sensory evaluation of toddy palm cake were tested on the basis of colour, flavour, taste, texture and overall preferences with 9-point hedonic rating scales by 30 untrained panelists [9].

Statistical analysis

The statistical analysis was carried out with ANOVA. The Duncan's New Multiple Range Test (DMRT) procedure was used to test differences between means. The results were considered significant at $p \leq 0.05$.

Results and Discussion

Production of toddy palm cake inoculum

The weight and diameter of toddy palm cake inoculum (T1, T3, T4, T5, T6 and T7) were 1.6-6.3 g/unit and 3.0-4.0 cm respectively, while the fermented sticky rice inoculum (T2) was 2.5-2.8 g/unit weight and 3.5-4.0 cm diameter. The colours of all inoculums are shown in Fig. 3. The lightness of all inoculums were different, being in the range of off-white to dark red-brown. The texture was diaphanous to dense and hard, depending on quantity of toddy palm flesh in each treatment.

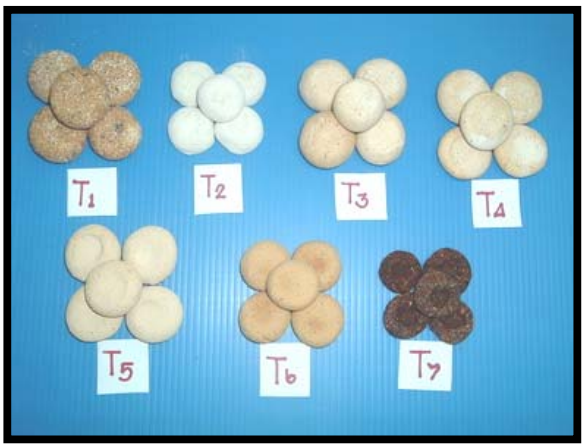

Figure 3. Inoculums used in producing toddy palm cake.
T1 = Inoculum without toddy palm flesh
T2 = Fermented sticky rice inoculum
T3 = 20% substituted toddy palm flesh inoculum
T4 = 40% substituted toddy palm flesh inoculum
T5 = 60% substituted toddy palm flesh inoculum
T6 = 80% substituted toddy palm flesh inoculum
T7 = 100% s ubstituted toddy palm flesh inoculum
(without rice flour)

The texture of toddy palm cake inoculums (T2, T6 and T7) was dense and very hard because of the high sugar and protein contents of toddy palm flesh in T6 and T7. High sugar and protein contents of ingredients in T2 were the main factors to produce caramelization and maillard reaction respectively. Both reactions affected the texture of toddy palm cake inoculums [10]**.** On the other hand, T1, T3, T4 and T5 were good quality inoculums. They were diaphanous and spongy, soft powder when pressed and no off flavours were detected [9].

Production of toddy palm cake with the addition of inoculums

In this research toddy palm cakes were off-coloured. Cakes produced by inoculums did not show as bright a yellow colour as the ones produced by palm flesh. Thus, 0.02% food dye of total ingredients was added to improve colour quality. The result showed that food dye addition could improve color quality of toddy palm cake produced by inoculums. In addition, leaven, softness and sponginess of toddy palm cakes were increased (Fig. 4).

Figure 4. Toddy palm cakes using inoculums.
T1 = toddy palm cakes consisted of inoculum without toddy palm flesh
T2 = toddy palm cakes consisted of fermented sticky rice inoculum
T3 = toddy palm cakes consisted of 20% substituted toddy palm flesh inoculum
T4 = toddy palm cakes consisted of 40% substituted toddy palm flesh inoculum
T5 = toddy palm cakes consisted of 60% substituted toddy palm flesh inoculum
T6 = toddy palm cakes consisted of 80% substituted toddy palm flesh inoculum
T7 = toddy palm cakes consisted of 100% substituted toddy palm flesh inoculum

Toddy palm cake leaven depends on dough extension due to yeast activity. Yeast in toddy palm flesh could produce CO_2 which increased dough volume before steaming. However, long fermentation times resulted in sour taste and depression of toddy palm cake [11]. The result found that mixing step, method and mixing time affected toddy palm cake leaven. Results from 30 untrained panelists showed the attributes of colour, flavour, taste, texture and overall preference scores were from dislike moderately to like very much in the score ranges of 6.40-7.90, 3.18-7.64, 6.90-7.60, 2.66-8.08 and 3.76-8.34 respectively, and were significantly different ($p \leq 0.05$) as shown in Table 1.

Table 1. Sensory evaluation scores of toddy palm cakes using inoculum.

Trts	Colour	Flavour	Taste	Texture	Overall preference
1	6.42 ^{a} ±0.8	3.18 ^{a} ±0.7	6.90 ^{a} ±0.8	2.66 ^{a} ±0.9	3.76 ^{a} ±0.8
2	6.44 ^{a} ±0.7	3.72 ^{b} ±0.9	7.26 ^{bc} ±0.8	3.58 ^{b} ±0.9	4.64 ^{b} ±0.6
3	6.40 ^{a} ±0.9	4.44 ^{c} ±0.8	7.56 ^{cd} ±0.6	4.46 ^{c} ±0.8	4.82 ^{b} ±0.7
4	6.70 ^{ab} ±1.0	4.44 ^{c} ±1.0	7.56 ^{cd} ±0.7	5.34 ^{d} ±0.8	5.10 ^{c} ±0.7
5	6.90 ^{b} ±0.9	6.46 ^{d} ±0.8	7.60 ^{d} ±0.7	6.82 ^{e} ±0.8	7.24 ^{d} ±0.8
6	7.30 ^{c} ±0.8	6.92 ^{e} ±0.9	7.22 ^{b} ±0.8	7.20 ^{f} ±0.8	7.66 ^{e} ±0.7
7	7.90 ^{d} ±0.9	7.64 ^{f} ±0.9	7.48 ^{bcd} ±0.8	8.08 ^{g} ±0.9	8.34 ^{f} ±0.7

* Means within the same column with different letter are significantly different ($p \leq 0.05$)
T1 = toddy palm cakes consisted of inoculum without toddy palm flesh
T2 = toddy palm cakes consisted of fermented sticky rice inoculum
T3 = toddy palm cakes consisted of 20% substituted toddy palm flesh inoculum
T4 = toddy palm cakes consisted of 40% substituted toddy palm flesh inoculum
T5 = toddy palm cakes consisted of 60% substituted toddy palm flesh inoculum
T6 = toddy palm cakes consisted of 80% substituted toddy palm flesh inoculum
T7 = toddy palm cakes consisted of 100% substituted toddy palm flesh inoculums

Physical and chemical characteristics

The three highest scores for toddy palm cake samples and conventional toddy palm cake were investigated. The colour value (L*, a* and b* values), hardness and springiness of toddy palm cakes with and without were tested and the results are shown in Table 2. There was significant difference ($p \leq 0.05$).

Table 2. Physical characteristics of toddy palm cakes.

Chemical composition	Treatments			
	1	2	3	4
Moisture (%)	57.1 ^{c} ±0.1	54.3 ^{b} ±0.4	43.1 ^{a} ±0.2	53.7 ^{b} ±0.5
Protein (%)	4.4 ^{c} ±0.1	4.1 ^{b} ±0.0	3.9 ^{a} ±0.0	3.9 ^{a} ±0.0
Crude fibre (%)	0.47 ^{ns} ±0.0	0.50 ^{ns} ±0.0	0.51 ^{ns} ±0.0	0.48 ^{ns} ±0.0
Ash (%)	0.05 ^{ab} ±0.0	0.04 ^{a} ±0.0	0.07 ^{bc} ±0.0	0.09 ^{c} ±0.0
Crude fat (%)	2.6 ^{b} ±0.0	2.5 ^{a} ±0.0	2.5 ^{a} ±0.0	2.5 ^{a} ±0.0
Carbohydrate (%)	36.0 ^{a} ±0.1	39.0 ^{b} ±0.4	51.1 ^{d} ±0.4	39.8 ^{c} ±0.6
pH	6.2 ^{c} ±0.0	5.8 ^{b} ±0.0	5.56 ^{a} ±0.0	6.4 ^{d} ±0.0
TSS (°Brix)	20.0 ^{a} ±1.0	26.0 ^{b} ±1.0	26.0 ^{b} ±1.0	30.0 ^{c} ±1.0

* Means within the same column with different letter are significantly different ($p \leq 0.05$)
T1 = toddy palm cakes consisted of 60% substituted toddy palm flesh inoculum
T2 = toddy palm cakes consisted of 80% substituted toddy palm flesh inoculum
T3 = toddy palm cakes consisted of 100% substituted toddy palm flesh inoculum
T4 = toddy palm cakes without inoculum

The results showed that the quality of toddy palm cakes produced using inoculum were lower than the ones produced by the conventional process. This was caused by the difference in the main ingredient (palm flesh) being substituted by inoculums that differed in their chemical composition, especially protein quantity. This also affected the texture quality of the cakes.

Table 3. Chemical composition of toddy palm cakes.

Trt	Colour value			Hardness (gram force)	Springiness (gram force)
	L*	a*	b*		
1	47.2 [c] ±0.3	5.7 [a] ±0.0	19.5 [c] ±0.1	4198.2 [d] ±0.2	0.95 [a] ±0.0
2	43.7 [b] ±0.1	8.9 [b] ±0.0	18.7 [b] ±0.1	4042.6 [c] ±0.4	0.97 [b] ±0.0
3	38.5 [a] ±0.3	10.5 [c] ±0.0	17.8 [a] ±0.0	2571.4 [b] ±0.3	0.96 [b] ±0.0
4	51.6 [d] ±0.3	10.6 [d] ±0.1	26.4 [d] ±0.3	1544.0 [a] ±0.4	0.98 [c] ±0.0

* Means within the same row with different letter are significantly different ($p \leq 0.05$)
[ns] are not significantly different at $p > 0.05$
T1 = toddy palm cakes consisted of 60% substituted toddy palm flesh inoculum
T2 = toddy palm cakes consisted of 80% substituted toddy palm flesh inoculum
T3 = toddy palm cakes consisted of 100% substituted toddy palm flesh inoculum
T4 = toddy palm cakes without inoculum

Normally, moisture content, protein, crude fibre, ash, crude fat and carbohydrate content of toddy palm cakes are 45.62, 3.92, 1.27, 0.46, 2.48 and 20.23% respectively [5]. The results from this experiment showed that the chemical composition of treatments which substituted with toddy palm flesh were similar when compared with conventional toddy palm cake (Table 2). Substitution of rice flour with toddy palm flesh resulted in changes for the better, i.e. increased protein content and decreased total soluble solid (TSS).

Sensory evaluation of toddy palm cake

Results from 30 untrained panelists showed the attributes of colour, flavour, taste, texture and overall preference scores were from dislike slightly to like very much in the score range of 4.50-7.60, 5.13-7.70, 6.37-7.67, 5.50-8.00 and 5.17-8.50, respectively, and were significantly different ($p \leq 0.05$) as shown in Table 4.

Table 4. Sensory evaluation scores for toddy palm cakes.

Trt	Colour	Flavour	Taste	Texture	Overall preference
1	4.5 [a] ±0.7	5.1 [a] ±0.7	6.6 [a] ±0.7	5.5 [a] ±0.9	5.2 [a] ±0.8
2	5.2 [b] ±0.8	5.7 [b] ±0.8	6.4 [a] ±0.5	6.0 [b] ±0.7	6.1 [b] ±0.8
3	6.3 [c] ±0.5	6.3 [c] ±0.9	6.6 [a] ±0.6	6.6 [c] ±0.8	7.1 [c] ±0.7
4	7.6 [d] ±0.7	7.7 [d] ±0.9	7.7 [b] ±0.7	8.0 [d] ±0.7	8.5 [d] ±0.6

* Means within the same column with different letter are significantly different ($p \leq 0.05$)
T1 = toddy palm cakes consisted of 60% substituted toddy palm flesh inoculum
T2 = toddy palm cakes consisted of 80% substituted toddy palm flesh inoculum
T3 = toddy palm cakes consisted of 100% substituted toddy palm flesh inoculum
T4 = toddy palm cakes without inoculum

This research found that sensory evaluation scores of both toddy palm cake with and without inoculums were similar even though there were some significant differences ($p \leq 0.05$). However, further study is needed to obtain a clearer picture of this.

Conclusion

Toddy palm cake inoculums can be used to produce toddy palm cake. However, the formula development for toddy palm cake when using inoculums should be optimized. When food dye (yellow) was added for colour improvement there were significant differences in physical characteristics. Further methods for quality improvement of toddy palm cake when using inoculums should be studied in the future.

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