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Effect of Natural Binder on Pang-Rum Hardness

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***Abstract*—**The aim of this study is to improve Pang-Rum (PR) hardness by adding natural binders. PR is one of Thai tradition aroma products. In the past, it was used for aesthetic propose on face and body with good odor. Nowadays, PR is not popular and going to be disappeared. Five natural materials, i.e. agar, rice flour, glutinous flour, corn starch, and tapioca starch were selected to use as binders. Binders were dissolved with boiled water into concentration 5% and 10% w/w except agar that was prepared 0.5% and 1% w/w. PR with and without binder were formulated. Physical properties, i.e. weight, shape, color, and hardness were evaluated. PR with 10% of corn starch solution had suitable hardness (14.2±0.9 kg) and the best appearance. In the future, it would be planned to study about odor and physical stability for decorated product development.

***Keywords*—**Aromatic water, hardness, natural binder, pang-rum.

I. Introduction

AROMA products such as aromatic water and Thai traditional perfumes have been used in Thailand for a long time. Aromatic water is clear water which solutes are aromatic or volatile substances. Amount of oil in aromatic water is very small because of low solubility [1]. It was used in drug formulations as flavoring agent or diluent [1], [2]. In Thai pharmacy, Thai herbal drug diluents were prepared from several methods, e.g. plants decoction, high water herbs squeeze, solutions from plant powder in hot water, herb grinding in water from washing rice and the last one, aromatic water which was prepared from essential oil, volatile oil or flower petals in boiled water [2].

Citrus hystrix DC fruit peel (Ma-grood, Pew) is one of the aromatic herbs which were recommended to be flavouring agent and carminative in Thai pharmacy. Fresh peel was used to prepare PR in this study. Reference [3] shows that Ma-grood, Pew is composed of volatile oil 2.0% v/w, and the major component is citronella.

Pang-Rum is one of Thai tradition incense products that were made in family for apply on face and body. PR odor is very specified, ancient, and charming. However, PR is not attractive especially in teenager groups.

From the reasons that PR should be conserved and its benefit should be increased, the tradition of PR had to be modified. The goal of this study is to develop stronger PR. We hoped that the product could be used as aromatherapy and fragrant decorated product in relaxing spa. Five food grade natural materials, i.e. agar, corn starch, rice flour, tapioca starch and glutinous flour were selected to be binders.

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Agar is a natural and nontoxic polysaccharide complex which is used in solid oral and topical dosage forms as stabilizing agent, thickening agent, binder, etc. [4]. Starch (e.g., rice starch, tapioca starch, corn starch) is an excipient in tablet which is used as binder, diluent, and disintegrant [4]. The difference between glutinous rice and normal rice is that glutinous rice has lower amylose and it is stickier when cooked than normal rice [5].

II. Materials and Methods

A. Materials

Rose essential oil was purchased from Hong Huat company, Thailand. Dried *Alyxia reinwardtii* Blume var. lucida Markgr, *Myristica fragrans* Houtt, fresh *Pandanus amaryllifolius* Roxb and *Citrus hystrix* DC were purchased from local market in Pathumthani, Thailand. Binders, e.g. rice flour, glutinous flour, corn starch, tapioca starch and agar were food grade.

B. Methods

1. Method 1: Prepare Pang-Rum

PR was prepared following by Klinjumpa method in [6] with slight modification.

1. White sugar, brown sugar, Siam benzoin and fresh *Citrus hystrix* fruit peel were freshly ground and mixed. It was called Krueng-Rum (Fig. 1).

Fig. 1 Krueng-Rum

2. Dried *Alyxia reinwardtii* bark, *Myristica fragrans* wood and fresh *Pandanus amaryllifolius* Roxb leaves were boiled in water, filtered, and poured in well-closed container. In this study, it was called aromatic water.
3. Powder was sterilized and put in well-closed container.
4. Aromatic water and powder (no. 2 and 3) were fumed with powder mixture (no.1) until smoke disappeared, repeated 15 consecutive times.
5. Aromatic water and powder (no. 4) were mixed gently with rose essential oil and borneol (PR paste).
6. Paste was kept in well-closed container overnight before use.

Binders were dissolved and heated to achieve 5% and 10%

w/w solutions (Starch paste was used in solid preparation with concentration between 5 – 10% w/w depending on starch type [4]) except agar that was prepared at concentration 0.5% and 1% w/w. Each binder was mixed into PR gently. Then, PRs with and without binder were weighed into the 2.5 cm x 2.5 cm silicone molds. Moister was free evaporated from product within a month. Dried products (PR) were collected in well-closed package and protected from light.

2. Method 2: Physical Properties Characteristic

Product weights were measured and calculated in terms of "solid content" (1):

$$\%\ solid\ content = \frac{PR\ weight}{PR\ paste\ weight} \times 100 \qquad (1)$$

Sizes of PR with and without binder were measured by vernier caliper. Physical appearances were determined by organoleptic method. Products were observed at all surfaces including color and texture.

Mechanical force that could break the product was measured in term "Hardness" [1]. The PR hardness in this study was examined by Pharma test type PTB 311E machine, Germany. Data were collected in triplicate and calculated mean±SD. The results were analyzed by one-way ANOVA with a significance level of 0.05 ($p<0.05$). Test of normality and homogeneity of variances were performed.

Fig. 2 Thai aromatic water and pang-rum

III. Results and Discussion

Fig. 2 shows original Thai aromatic water and pang-rum souvenir set. The original pang-rum was formed into raindrop because of it was made by funnel shaped banana leave. Whereas in this study, it was designed to quadrangle shape because it was easy to control and measure. Physical properties of PR with and without binders were investigated.

Solid contents of all PR were between 36.71±0.47 to 40.36±0.52. Results showed that PR products before drying were composed of water more than 50% w/w. Moisture in PR paste was free evaporated within 30 days, and PR products were formed solid formulation.

Sizes of PR with and without binder were measure and data were shown in Table I. Width and length of PR with both agar concentrations were shorter than PR without binder whereas height was higher. It might be incompatible between agar and powder in product. PR with corn starch solution, rice flour solution, glutinous rice flour solution and tapioca starch solution had width, length and height similar as PR without binder.

PR aesthetic appearances were shown in Table II. Side surface colors of all products were not different (they were light brown). The most top colors were medium brown except the PR with both concentration agar solutions that were slightly darker than the others.

Each product shape was quadrangle. PR without binder, with both concentrations of corn starch solution and rice flour solution had smooth top surface, whereas PR with both concentrations of agar solution, glutinous flour solution, and tapioca starch solution collapsed in the middle of top surfaces. Edges of the most products were rough except PR without binder and PR with both concentrations of corn starch solution. Only PR with both concentrations of corn starch binder did not leave residual powder at silicone mold bottom. We found that PR with corn starch binder had the best appearances, not only shape but also texture and mass aggregation.

From the results in Tables I and II, we found that agar solution should not be used as binder because it affected aesthetic appearance of the product, e.g. size, color, and texture.

TABLE I
PR With and Without Binder Sizes (N=3)

No.	PR product	Size (wide x length x height)
1	without binder	2.24 cm x 2.24 cm x 0.91 cm
2	with 0.5% agar solution	2.16 cm x 2.14 cm x 1.01 cm
3	with 1% agar solution	2.09 cm x 2.04 cm x 1.17 cm
4	with 5% corn starch solution	2.11 cm x 2.11 cm x 1.12 cm
5	with 10% corn starch solution	2.24 cm x 2.24 cm x 0.91 cm
6	with 5% rice flour solution	2.23 cm x 2.20 cm x 0.99 cm
7	with 10% rice flour solution	2.23 cm x 2.24 cm x 0.96 cm
8	with 5% glutinous flour solution	2.23 cm x 2.23 cm x 0.99 cm
9	with 10% glutinous flour solution	2.23 cm x 2.22 cm x 0.98 cm
10	with 5% tapioca starch solution	2.23 cm x 2.23 cm x 0.99 cm
11	with 10% tapioca starch solution	2.22 cm x 2.22 cm x 0.99 cm

TABLE III
PR with and Without Binder Hardness (N=3)

No.	PR product	Hardness (kg)
1	without binder	6.2 ± 0.4*
2	with 0.5% agar solution	6.0 ± 0.3
3	with 1% agar solution	9.1 ± 0.1*
4	with 5% corn starch solution	9.7 ± 0.4*
5	with 10% corn starch solution	14.2 ± 0.9*
6	with 5% rice flour solution	8.9 ± 0.5*
7	with 10% rice flour solution	11.8 ± 0.3*
8	with 5% glutinous flour solution	11.0 ± 0.5*
9	with 10% glutinous flour solution	17.4 ± 0.5*
10	with 5% tapioca starch solution	9.9 ± 0.4*
11	with 10% tapioca starch solution	14.8 ± 0.6*

*significant difference between groups ($p<0.05$)

Table III shows that hardness of PR with binder was also higher than PR without binder significantly ($p<0.05$) except PR with 0.5% w/w agar solution. Results were supported data from Table I and II that agar might be incompatible with powder in PR product. Higher concentration of all binders could increase PR hardness more than lower concentration. It correlated with the result from [5]. Reference [5] shows physicochemical properties of glutinous rice starch compared with corn starch when they were used as tablet excipients. They found that both glutinous rice starch and corn starch at higher concentration had binding property more than at lower concentration significantly.

The third highest hardness of products were PR with 10% w/w solution of glutinous flour, 10% w/w solution of tapioca starch, and 10% w/w solution of corn starch, respectively. Whereas PR with glutinous flour solution and tapioca starch solution had collapse top surfaces and rough edges (Table II). Furthermore, effects of 10% w/w solution of tapioca starch and 10% w/w solution of corn starch solutions on product hardness were not different ($p>0.05$).

TABLE II
APPEARANCES OF PR WITH AND WITHOUT BINDER

No.	PR products	Figure	Surface color	No.	PR products	Figure	Surface color
1	without binder		Top ++ Side +	7	with 10% rice flour solution		Top ++ Side +
2	with 0.5% agar solution		Top +++ Side +	8	with 5% glutinous flour solution		Top ++ Side +
3	with 1% agar solution		Top +++ Side +	9	with 10% glutinous flour solution		Top ++ Side +
4	with 5% corn starch solution		Top ++ Side +	10	with 5% tapioca starch solution		Top ++ Side +
5	with 10% corn starch solution		Top ++ Side +	11	with 10% tapioca starch solution		Top ++ Side +
6	with 5% rice flour solution		Top ++ Side +	Surface color: light brown (+), medium brown (++), dark brown (+++)			

IV. CONCLUSIONS

From the results, we found that agar was not be used because it could not be compatible with PR, e.g. smaller width and length, darker top surface color, and rough surface edge. PR with rice flour solution binder had smooth top surface but its hardness was not high enough.

From the third highest hardness PR product, they were found that glutinous flour solution 10% w/w could increase PR hardness more than others but physical appearances of the product were not satisfied, e.g. collapse top surfaces, rough edges and it had much residual powder at mold bottom. PR with corn starch solution 10% w/w was slightly softer than PR with tapioca starch solution 10% w/w but not different ($p>0.05$); however, shape and texture were better.

Because of PR with corn starch solution 10% w/w had suitable hardness and the best appearances including size, color and texture surface, it was chosen to further study about physicochemical stability and odor release. Finally, it would be improved aesthetic shape for commerce.

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