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Saponin Maintaining and Dose Determining in Carica Papaya Leaf Cookies as a Breast Milk Booster (*galactogogue*)

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ABSTRACT

Background: Papaya leaf has been proven to increase breastmilk production as the saponin content increases oxytocin level. However papaya leaf has a bitter taste, therefore cookies form is a good alternative to increase compliance. Saponin content has to be maintained and the dose should be determined to be an effective breastmilk booster (*galactogogue*).

Objective: This study aimed to find the best process in 1. Minimizing the bitter taste of papaya leaf, 2. Maintaining saponin content of cookies, 3. Finding the highest dose of acceptable cookies, and 4. Determining the amount of cookies has to be consumed by lactating mothers as a breastmilk booster.

Method: For minimizing the bitter taste of *Carica papaya* leaf we compared the pH level of mashed papaya leaf after three different treatments. For saponin maintaining, we compared two different temperature and duration of baking processes. Hedonic tests were performed to find the dose of papaya leaf cookies which were acceptable. The number of cookies should be consumed was calculated based on amount of saponin in the cookies, which had been shown to have an effective outcome.

Findings: This study found that *Carica papaya* leaf which was boiled twice in 60°C for 10 minutes had the lowest pH compared to be soaked in 2.5% volume of quicklime (calcium oxide) solution or 10 minutes boiled in the cooked rice water. Baking *Carica papaya* leaf cookies in 60°C for 70 minutes could maintain saponin content compared to be baked in 130°C for 35 minutes. Hedonic test results showed that there was no significant differences in acceptability levels of *Carica papaya* leaf content between the groups. A hundred gram cookies with 40% *carica papaya* leaves contained 3.67g saponin, thus for 1.8g saponin intake/day in two cookies of 25g should be consumed.

Conclusion: The best method in reducing the bitter taste of *Carica papaya* leaf cookies was by boiling in 60°C for 10 minutes. Saponin content in the cookies could be maintained by 60°C for 70 minutes baking. The highest dose but acceptable taste of *carica papaya* leaf cookies was 40%. Two pieces of 25g *carica papaya* leaves cookies can be consumed as *galactogogue*.

Keywords: *Breastmilk booster, Carica papaya, Cookies, galactogogue, saponin.*

Introduction

Exclusive breastfeeding is important for baby's growth and health¹. However, many problems occur in exclusive breastfeeding practice. One of the important problems was breastmilk production insufficiency. Many efforts

have been conducted to increase breastmilk production, including medical treatment and herbal *galactogogue* consumption.² In Malaysia, 87% of insufficient breastmilk problems were overcome by herbal *galactogogue* because it is considered safer and more available.³ In Thailand herbal *galactogogue* such as banana heart (*Musa acuminata*), basil (*Ocimum*), water pumpkin (*Lagenaria siceraria*), pumpkin (*Cucurbita*) had been shown to be significantly associated with milk production.⁴ In Indonesia katuk leaves (*Sauropus androgynus* (L) Merr) increased milk production to 50.7%.⁵

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Some plants including Carica papaya leaf can increase milk production because they contain certain compounds and minerals.⁶ Compared to katuk leaves, papaya leaves contain mangan and potassium which increase prolactin and oxytocin hormones for milk forming and milk ejecting.^{5,6} Furthermore Carica papaya leaves are more available in Indonesia than katuk leaves. However, the bitter taste caused by of carpain alkaloid content in carica papaya is the main reason for their unconsumption.⁷ Preparing of Carica papaya leaves in the form of cookies, may enhance the acceptance level of papaya leaves as a source of saponin. Processing Carica papaya leaves into cookies has some benefits of a much better taste, easier to consume at any time and less perishable.

Materials and Method

The materials used in this study were Carica papaya leaves processed in the form of cookies. Several steps were carried out to get cookies that contained saponin from carica papaya leaves in a less bitter taste, acceptable in taste and proper dose in administering. The first step was reducing the bitter taste of Carica papaya leaves. The method of the first step was comparing pH level of the mashed leaves that already processed with three different treatments. The first treatment was boiling the leaves at 60°C for 10 minutes and discharged the water. Then the leaves were boiled again with the same temperature for another 10 minutes.⁸ The second treatment in minimizing the bitter taste of papaya leaves was soaking carica papaya leaf in 2.5% volume of calcium oxides solution (25g calcium oxides in 1000 ml water) for 90 minutes. The third treatment was boiling papaya leaves in the cooked rice water for 10 minutes. Cooked rice water was made by boiling 250g rice in 1000ml water.⁹

The methods for maintaining saponin in carica papaya leaf cookies were found by comparing 2 baking processes (in different temperature and duration). The temperature which generally used for cookies is 130°C in 35 minutes.¹⁰ However saponin is damaged at temperature higher than 60°C of heating.¹¹ Therefore we compared the saponin content of cookies baked in 130°C for 35 minutes and 60°C for 70 minutes. In 70 minutes, cookies were ready looked yellowish and have a crunchy texture.

The method used in determining the degree of acceptability was hedonic test. Untrained panelists of breastfeeding mothers were employed in this test. They were provided with the cookies containing 0%, 10%, 20%, 30% and 40% carica papaya leaves. Then, they were requested to taste the cookies alternately, with 5 minutes space of time. Panelists were allowed to drink mineral water in order to neutralize the taste. After that the panelists were asked to gave a score according to the level of taste acceptance in the range of extremely like (6), very much like (5), moderately like (4), slightly like (3), neutral (2), unlike (1).¹² Furthermore, data was categorized in accepted and not accepted. The accepted category toward the taste of cookies was determined when the panelist stated extremely like, very much like, moderately like, slightly like and neutral.

The taste of cookies was not accepted when the panelists stated dislike. Univariate analysis was used to find the distribution of accepted and not accepted cookies in several doses. Normality of data in each variable was tested using Saphiro Wilk test. Data analysis in the two group showed that all data was not normally distributed, therefore Mann-Whitney test were used to compare between scores of each dose Carica papaya leaves content with other dose in related with level of acceptability.¹³

The dose of Carica papaya leaf cookies as breast milk booster was determined by calculating the saponin content. Saponin was tested using a UV-vis spectrophotometry method. Previous study¹ done in Tehran on 2013 involving of 78 Iranian girl infants 0-4 months old showed that 1.8g saponin a day in the fenugreek seed tea was able to increase the breast milk production.¹⁴ Based on that finding the dose calculation could be done with the formula below:

$$\frac{\text{Saponin content in the cookies}}{100 \text{ g}} = \frac{1.8 \text{ g saponin}}{X}$$

$$X = \frac{100 \times 1.8}{\text{Saponin content in the cookies}}$$

The process of making carica papaya leaf cookies is as follows: blending 40g Carica papaya leaves, mixing with 60g wheat flour, 50g sugar, 40g margarine, 17g egg yolks, 10g skim milk, 1g baking soda and 0.5g salt using an electric mixer. Round cookies with a diameter of 5cm was formed from the and then baked. Baking process was terminated when the cookies was cooked.¹⁵ The

sign of cooked cookies are yellowish color and crunchy texture. The same procedures were applied in making of 0%, 10%, 20%, and 30% of carica papaya leaf cookies.

Findings

The findings was explained based on 4 goals of of this research, which are:

Reducing the Bitter Taste: For reducing the bitter taste, three different methods were compared to find pH level as an indicator for a bitter taste, the lowest pH will be chosen as the sign of the least bitter taste from several methods. The lower the pH, the more acidic the solution. Lowering the pH produced the biggest increase in sourness of food and results in less bitter taste.¹⁶ Table 1 shows the pH levels resulted from different several treatments. It can be seen from the table that the lowest pH in carica papaya leaves was 7.70, therefore the best method in reducing bitter taste was boiling leaves twice in the temperature of 60°C.

Table 1: pH levels of carica papaya leaf after three different treatments

Treatments	Ph level
Boiling twice in 60°C for 10 minutes	7.70
Boiling in cooked rice water for 10 minutes	7.84
Soaking in 2,5% calcium oxide solution for 90 minutes	8,13

The bitter taste in the Carica papaya leaf was caused by alkaloid carpain substance (C₁₄H₂₅NO₂).⁷ Boiling is the most practice method for bitter taste elimination, because of decomposition process of alkaloid carpain.⁹ Carpain is not related with the function of carica papaya

leaf as a breast milk booster. Therefore reducing a bitter taste did not influence the effect of carica papaya leaves as a breastmilk booster. The most reason of the low enthusiasm in consuming Carica papaya leaf among Indonesia communities is the strong bitter taste.¹⁷ Therefore reducing the bitter taste will increase the acceptibility of Carica papaya leaves.⁷

Baking Process: Two methods of baking process were compared to find the best method in maintaining the saponin content of Carica papaya leaves. The saponin content should be maintained maximally for galactogogue purpose. Table 2 shows two different baking processes (based on the temperature and duration) of cookies and the saponin content after treatments.

Table 2: Saponin content in 100g cookies after two different baking processes

Baking Process	Saponin
Temperature of 130°C for 35 minutes	(-)
Temperature of 60°C for 70 minutes	3.67g

Table 2 reveals that saponin was totally damaged by the baking process of 130°C in 35 minutes. The heat of > 60°C damages the saponin stucture.¹¹ Therefore the best temperature of baking to maintain saponin content was 60°C. After 70 minutes, the cookies were already cooked and crunchy.

Hedonic Test: Thirty-nine breast feeding women were employed as panelists in the hedonic test. They were served with the cookies containing 0%, 10%, 20%, 30% and 40% carica papaya leaves. Table 3 shows the percentage of acceptability of several different doses Carica papaya leaf cookies.

Table 3: Taste acceptability level cookies with several different doses of Carica papaya leaf

Papaya leaf content	Accepted												Not accepted unlike		Total	
	extremely like		very much like		moderately like		slightly like		neutral		Total accepted		n	%		
	n	%	n	%	n	%	n	%	n	%	n	%			N	%
0 %	8	20.5	9	23.1	8	20.5	11	28.2	2	5.1	38	97.4	1	2,6	39	100
10 %	5	12.8	9	23.1	9	23.1	13	33.3	2	5.1	38	97.4	1	2,6	39	100
20 %	4	10.3	8	20.5	9	23.1	12	30.8	4	10.3	37	94.9	2	5,1	39	100
30 %	3	7.7	7	17.4	10	25.6	12	30.8	4	10.3	36	92.3	3	7,7	39	100
40 %	2	5.1	6	15.4	9	23.1	13	33.3	6	15.4	36	92.3	3	7,7	39	100

Table 3 shows that the percentage of dislike panelist was slightly increased with the increasing amount of Carica papaya leaves in cookies. However, most of panelists accepted the taste of 0%-40% Carica papaya leaf cookies. Furthermore we also conducted acceptability test between two groups of cookies based on the amount of carica papaya leaf content.

Table 4: Comparison of acceptability levels between two groups of papaya leaf content

Compared cookies	P*
10% - 20%	0.465
10% - 30%	0.232
10% - 40%	0.052
20% - 30%	0.648
20% - 40%	0.237
30% - 40%	0.466

*Mann-Whitney

Table 4 shows that there was no significant difference in acceptability levels of Carica papaya leaf content between the groups. The acceptability between 30% and 40% of Carica papaya leaves in the cookies was not different. Therefore we used 40% carica papaya leaf cookies for galactogogue purpose and use it for dose calculation.

Dose Calculation: The laboratory test shows that there was 3.67g saponin in 100g of 40% Carica papaya leaf cookies. This finding was used to calculate the dose of cookies. The need of saponin content for galactogogue based on previous research was 1.8g a day.¹⁴

The calculation of the dose:

$$X = \frac{100 \times 1.8 \text{ g}}{3,67 \text{ g}}$$

$$X = 49\text{g}$$

Forty nine grams was rounded to 50g, thus 2 pieces of 25g Carica papaya leaf cookies fulfilled the need of saponin content as galactogogue. Two pieces of cookies a day was also feasible to be consumed as snack.

Other than saponin, Carica papaya leaves also contain potassium and mangan which also have galactogogue effect. Laboratory test results showed that there was 1,6mg/g potassium in the cookies. Women in 19-29 years old need 470mg potassium everyday.

Lactating mothers need an additional 40 mg potassium per day. Thus potassium need of lactating mothers is 510mg/day.¹⁸ Two pieces of 25g Carica papaya leaf cookies contained 80mg potassium, which supplied 15.7% potassium need for lactating women per day

Carica papaya leaf cookies contained 0.01mg/g mangan. The need of mangan for adult women is 1.8mg/day. During lactation period, the women need additional 0.8mg additional mangan per day. Thus 2.6mg mangan is needed by lactating mothers everyday.¹⁸ Two pieces of 25g cookies contained 0.50mg mangan which contributed to 19,2% mangan need for breastfeeding mother.

Mangan and potassium can stimulate the production and activity of prolactin and oxtocyn. Mangan content in Carica leaf cookies stimulated pituitary gland in producing prolactin, which increase breast milk production. Potassium deficiency caused tiredness and mood swings which inhibited oxtocin production. Potassium has relaxing effect, thus may stimulate oxtocin production which is needed for breast milk ejection.²

Conclusion

The best process of making papaya leaves cookies which can be used as galactogogue was boiling leaves twice at ≤ 60°C before adding other ingredients and bake the cookies of 40% Carica papaya leaves in 60°C for 70 minutes. Two pieces of 25g papaya leaves cookies every day can be consumed by lactating mothers as a galactogogue (breastmilk booster).

Conflict of Interest: The authors have no conflict of interest related with conducting and reporting this study.

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Ethical Clearance: This study was approved by the Ethic Committee for Health Research, Faculty of Public Health, Diponegoro University (No.079/EC/FKM/2018).

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