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Improvement of Noodles Recipe for Increasing Breastmilk: Design of the Moringa Noodles

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Abstract This research aims to seek the method of making noodles through a substitution using *Moringa oleifera* leaf flour functioning to maintain its *lactagogum* effects. The method of the research, meanwhile, is in vivo using Wistar Rats (*Rattus norvegicus*) and weighing method is used in obtaining data. A number of treatments were conducted in this research including standard food, noodles without any *Moringa oleifera* leaf flour, sautéed Moringa noodles, steamed noodles, and boiled noodles in which the results of these are compared to the mice that have not ever breastfed and the ones have. In this case, the data obtained are in the form of mammae female mice. The result of the research then reveals that the female rat given with the sautéed Moringa noodles have more mammary glands and its offspring averagely have higher weight increase compared to other. It then can be concluded that noodles with a sautéing processing method are the ones with the best treatment.

Keywords: *Moringa oleifera Lamk, lactagogue, noodles*

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1. Introduction

The deficiency of nutrient intake and infection are two direct factors of malnutrition towards baby and child (Nambiar and Seshadri, 2001, Sutomo, 2009, UNICEF. 1999). This, as a consequence, brings the effect on the lack of both macronutrient and micronutrient that are really required for the early child growth and development. Fulfilling the nutritional needs for infants at 0 to 6 months old is absolutely obtained from exclusive breastfeeding (Butte, Lopez, Garza, 2002, Kramer, Kakuma, 2002, WHO 2003). In response to this, the improvement of nutrition of the 0 – 6 month-old infant is implemented through the improvement of maternal nutrition before and during exclusive breastfeeding period. This is in consideration to that the malnutrition at the age less than 2 years will bring an effect on the disorders of physical growth, brain development, intellectuality, and productivity in which most of these impacts are *irreversible*.

A number of studies in many developing countries reveal that the main factor of malnutrition and the hindrance of growth of 3 to 5-month infants are tightly correlated to the low breastfeeding rate (Machado, et al., 2009, Shrimpton, 2001). In Indonesia, it is found that the rate of infant obtaining the exclusive breastfeeding until 5 month was only at 14% and those obtaining the exclusive breastfeeding until 6 month was only 8% (Health Department of Indonesia Republic, 2003). It is also reported from the result of a survey that 38% of mothers stop giving breastfeeding for the infants by reason of insufficiency of breast milk production (Sa'roni, et al., 2004).

Seeing the importance of mother breast milk, the government attempts to campaign the significance of breastfeeding for mothers. It is found that not all mothers just giving a birth to baby are able to breastfeed at ease – thus impelling to use any chemical or traditional medicines that are able to make breast milk smooth (i.e. having lactagogum effect). *Moringa oleifera* leaves have certain quality as lactagogum (i.e. increasing breast milk secretion) (Doer. B. and Cameron L. 2005, Estrella, Mantaring and David, 2000, Fuglie, 2001. Madrano and Perez, 2005) as containing phytosterol compound (Sa'roni, et al., 2004).

Using *Moringa oleifera* as a foodstuff to expedite the breast milk secreted is coming to be a new challenge by considering that in Indonesia it has been viewed inferior [6], taboo to be consumed for certain reasons (Suhardjo. 1989), used as an anti-witchcraft plant or helpful to fight the black magic practices in Indonesia (Windadri, Rahayu, and Rustiami, 2006).

Moringa oleifera flour is one of foodstuffs used in the process of making dried noodles as an improvement of foodstuff that can enhance the productivity of mother breast milk. In Indonesia, noodles for the taste, practicality and satiation have been becoming a favorite food for walks of life started from children to elders. Having high carbohydrate content, noodles, instead of rice, then are used as the carbohydrate sources (Moyo, 2011).

The intention to result in food that can enhance the productivity of the mother breast milk must concern with

some factors determining the lactagogum effects. Considering that more than 90% of manufacturing process can damage the content of lactagogum compound, it becomes essential to consider the effect of the process on lactagogum. A process, in this case, must concern to maintain the compound condition that can increase the production of breast milk.

In response to the discussion above, it is necessary to conduct a research on the stability of Moringa Oleifera in the manufacturing process in order to determine a number of parameters to control the handling process in *hospitality industry*. In this case, the methods of making noodles used in this research are by sautéing, steaming and boiling in order to measure the lactagogum effects of *Moringa oleifera* noodles. The observed parameters are referred to the alveoli of lactated Wistar Rats (*Rattus norvegicus) and the increase of the weight of rat offspring*.

2. Material and Methods

2.1. Materials

The leaves of *Moringa oleifera* were obtained from Landungsari Village, Sub-district of Dau, Malang Regency. The leaves harvested here were the ones in the third and fourth stalks from the tip of the leaf from 1-year old plant that had not borne fruit before.

A pregnant Wistar Rats (*Rattus norvegicus)* at 2 – 3 months old should be around 195-204 grams in weight. The standard food of AIN93G was used as food for controlled rats. Meanwhile, noodles are with the methods of sautéing, boiling and steaming.

2.2. Methods

This research was conducted through *Randomized Block Design* for testing effect of lactagogum. The research object was a mouse given *Moringa* noodles. For the preference test, 60 panelists in this case breastfeeding mothers in Pamotan Village, Malang, Indonesia were involved.

Moringa leaf flour was mixed into formula of noodles product for one meal (85g). The weight of noodles was adjusted with the average weight of noodles as distributed in market for one meal only. The amount of Moringa leaf meal, in this case, was based on the result of a research conducted by Mutiara et al [2012].

Seven rat cages, 36 cm x 28 cm x 12 cm plastic boxes, were used in this research. Prior to care for the rat, the cages were firstly cleaned using detergent and given 70% alcohol. The classification for the seven cages was based on the following treatments: Cage 1 was for the rat under the treatment of control food (standard food), and Cage 2 was for the rat under the treatment by giving the rat with Moringa noodles, which were made using steaming process. Meanwhile, Cage 3 was for the rat given with Moringa noodles made using a boiling process and in Cage 4, the rat was under a treatment by giving the rat with Moringa noodles, which were made using a sautéing method. Furthermore, Cage 5 was for the rat under a treatment by giving noodles without any *Moringa oleifera* leaf, Cage 6 was for the rat that has not ever given a birth and given with standard food, and lastly Cage 7 was for the one that has ever given breastfeed and was given with the standard food. In this case, each of cages was completed with one drinking bottle made of glass and in capacity of 265 ml and a food place that was previously disinfected.

The amount of food given in a day was at 40 grams for each cage with an assumption that the normal rat (not pregnant ones) had a normal habit of meal at the amount of 20g/day. In this case, drinking water was also provided. The floor of each cage, meanwhile, was covered by saw powder - especially for the base of pets. The saw powder was going to be replaced in every morning at the feeding time and the rest of food was also taken or removed in order to avoid the piling up of the waste and urine of rat in the cage; thus possibly to minimize the risk of disease. Feeding was given at 06.00-07.00 a.m. and time of adaptation for rats took for one week from the beginning of being replaced in the cage. The feeding of treatment food was done when the pregnancy of the rat was at 14^{th} day until 10 days after bearing. The 14^{th} day was the most accurate day as it could bring the highest positive effect on the reproductive power of the rat (Windadri, Rahayu, and Rustiami. 2006).

An indirect method was conducted to measure the increase of productivity of breast milk through the calculation of the number of mammary glands alveoli of the average lactation in the female rat. In addition, an observation was done once in two days towards the increase of weight of rat offspring. At the end of the treatment day, all female rats would be sacrificed to take the mammary glands in a similar location that is inguinal. The mammary glands were subsequently made as histological supply using hematoxylin eosin (HE) coloration to calculate the amount of alveoli using microscope at 400 times magnification. The calculation of the amount of alveoli on average of blood smear was conducted in three areas of observation: end, middle, and beginning, each of which was examined using light microscopy at 400 times magnification. The result of calculating the amount of mammary glands alveoli was then compared to the blood smear of mammary glands of the rat that had not borne and the one that had ever.

2.3. Statistical Analyses

The obtained observation data was processed using ANOVA test and continued by Least Significantly Difference (LSD) test processed using SPSS *for Windows* series 16.

3. Result and Discussion

3.1. The Weight Increase of Rat Offspring

The result of the research on the effect of giving *Moringa oleifera* noodles on the increase of breast milk productivity of the female rats and the udder gland enlargement of rats with a variety of processing treatment are elaborated as follows. The phase of the growth of the rat offspring after the bearing period was very varied in each treatment. In this research, the level of the offspring level was represented through its weight. The data that had been obtained, afterwards, were tested using the single variant analysis (ANOVA) at the significance level of 5%. The result of this analysis was continued by further test

using LSD (Least Significantly Different) at similar significance level (i.e. 5%).

Table 1 below presents the data in detail and Figure 1 presents the data of the weight increase.

Table 1. Birth Weight and Weanling (10 days), and the Increase of Weight in each average of Experimental Group

The Observed Parameter		Food Treatment				
		Standard Food	Noodle without Moringa	Boiled Moringa Noodles	Steamed Moringa Noodles	Sautéed Moringa Noodles
Female Weight (g)	After Parturition	135	160	200	200	162
	5 days after parturition	129	154	188	193	158
	10 days after parturition	157	144	161	175	134
Number of Pups		6	8	9	12	12
Birth Weight per Offspring (g)		5,35±0,07^{ab}	5,74±0,05^{ab}	4,85±0,45^{a}	5,83±0,57^{b}	5,15±0,13^{a}
Weight in weaning offspring		8,31	12,01	10,89	13,73	13,76
Increase of Weight (g)		2,536	6,26	6,01	7,84	6,27
Increase of Weight per food (g)		0,14±0,12^{a}	0,23±0,23^{b}	0,27±0,27^{bc}	0,29±0,29^{c}	0,37±0,37^{d}

Remarks:

The number followed by different superscript letters in the same lines shows a significant difference (α = 5%). Each of data refers to the average of five times of repetition.

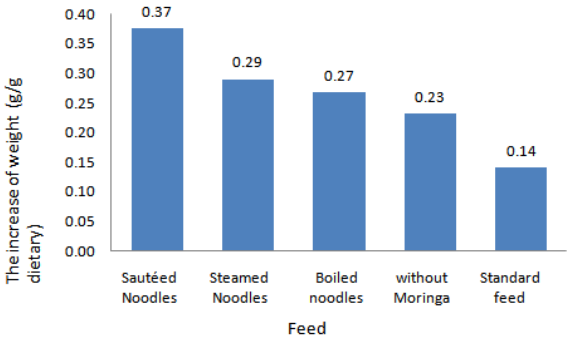

Figure 1. The Increase of Weight of Rat Offspring (g/g dietary/day) within 10 days (LSD = 0,023)

Based on Figure 1, it is found that the average at the increase rate of the rat offspring weight to the rats with the standard food was 0, 14 g/g dietary. The secretion of the breast milk here tended to increase in the female rat given the treatment of noodles fortified with the *Moringa oleifera* meal. It can be seen from the weight of the rat offspring reaching at 0, 25 - 0, 37 g/ g dietary.

3.2. The Increase of the Number of Mammae Glands

Based on the result of the research, it shows that the female rat fed with Moringa noodles could increase its breast milk secretion. A different processing treatment on Moringa noodle could increase had an effect on the increase of the secretion of the breast milk towards the female rat. The effect of distributing *Moringa oleifera* noodles towards the increase of the productivity of breast milk of udder glands in rat shows a positive result that is from the increase in number and the enlargement of mammary gland alveoli in female rat. The average of the number of mammary gland alveoli in breastfeeding female rat in control was lower (140, 67) than that of the group of treatment. The result of the statistic test using ANOVA in degree of confidence of 95% shows a significant difference among seven treatments with the value p<0,001.

The result of the statistic test using *post hoc test* of LSD (Least Significantly Different) at the degree of confidence 95% shows a significantly different effect of *Moringa oleifera* on the increase of the average number of mammary gland alveoli between the breastfeeding female rat and the one that has not given breastfeed or the one after period of breastfeeding with the value p<0,001.

An insignificant difference was found between the rat that has not ever given breastfeed and the female rat after the breastfeeding period. This can be explained that in rats, pregnancy takes less than 21 days. During pregnancy, the udder glands will experience a significant improvement influenced by progesterone causing the growth and the development of mammary gland alveoli. Once the female rat comes to the end of the pregnancy period, progesterone is still high purposely to avoid the breast milk secretion influenced by prolactin. After parturition happens, progesterone gradually decreases and prolactin increases. For more or less 3 weeks, the rat will come to involution period in which alveoli will be back to a normal condition [11].

Table 2 shows the result of the measurement using ANOVA test and LSD test.

Table 2. The result of Measurement of the total number of alveoli

No	Treatment	Number of the upper mammary glands	Number of the middle mammary glands	Number of the lower mammary glands	Total of mammary glands	Average	Notation
1	Teenager	48	52	50	150	50	a
2	Post-breastfeeding	110	100	88	298	99,33	a
3	Control Food	100	132	190	422	140,67	b
4	Noodle without Moringa Oleifera	106	270	150	526	175,33	bc
5	Boiled Moringa noodles	277	327	169	773	257,67	cd
6	Steamed Moringa noodles	274	300	284	858	286	d
7	Sautéed Moringa noodles	391	389	368	1148	382,67	e

Remarks:

Each data refers to the average of three times repetition.

The numbers in the columns with different letters in each treatment explain the significant difference (LSD 5% = 39,361).

The number of the average of mammary glands in female rats under a treatment of giving Moringa noodles using a boiling processing method did not result in a significant difference with the mammary glands in the female rats given Moringa noodles under a steamed processing method but it had a significant difference with the treatment of giving noodles without *Moringa oleifera* and control. This then indicates that the addition of Moringa Oleifera meal can bring an effect on the increase of the number of mammary glands in female rats.

The highest number of the average of mammary glands was found in the female rat given with the Moringa noodles using sautéing processing method. It was due to the addition of vegetable oil in the making process. In this case, palm oil contains campesterol, Stigmasterol and β-sitosterol close to 300 ppm [11].

The development of the lobes of mammary glands is highly influenced by estrogen and progesterone. Here, estrogen can cause the fat precipitation in mammary glands, development of stroma tissue of mammary glands and the growth of a wide channel system. Lobules and alveoli of mammary glands little bit grow but progesterone and prolactin determine the growth and the functions of these structures [7]. The lactagogum effect given by Moringa Oleifera shows a good result towards the increase of the productivity of the breast milk of mammary gland that can be seen from the increase of the glands and enlargement. Figure 2 presents the histology of mammary glands.

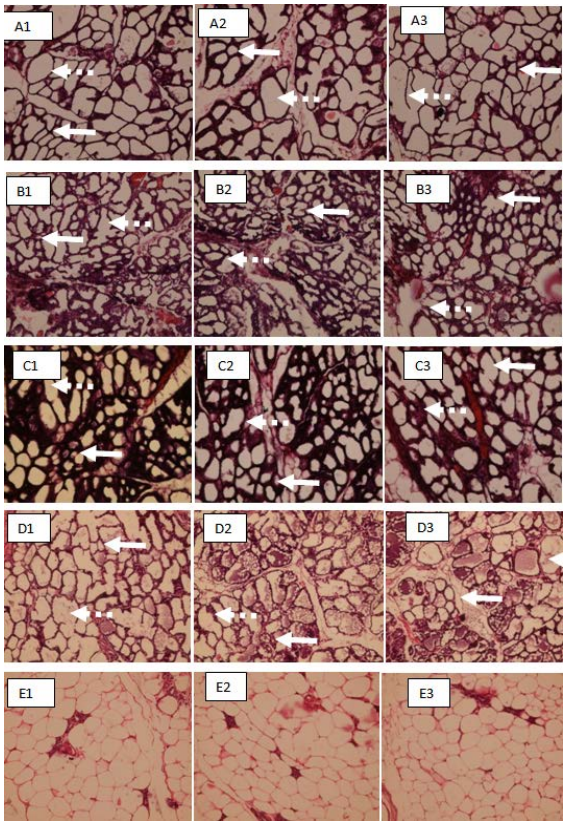

Figure 2. The description of histology of mammary glands in female rat (400 x magnifications)

Remarks:

1. Mammary glands of female rat under the treatment of sautéed Moringa noodles. (A1) lower part, (A2) middle part, and (A3) upper part.
2. Mammary glands in female rats under the treatment of boiled Moringa noodles. (B1) middle part, (B2) lower part, (B3) upper part.
3. Mammary glands in female rats under the treatment of steamed Moringa noodles. (C1) lower part, (C2) middle part, (C3) upper part.
4. Mammary glands in female rats under the treatment of noodles without Moringa. (D1) lower part, (D2) middle part, (D3) upper part.
5. Mammary glands in female rats after breastfeeding period (E1) lower part, (E2) middle part, (B3) upper part
6. Mammary glands in breastfeeding female rats under the treatment of comfeed pars. (F1) lower part, (F2) upper part, (B3) middle part
7. Mammary gland in rats that had not ever given a birth (G1) lower part, (G2) middle part, (G3) upper part

= inactive glands are smaller in size

= Active glands are bigger in size

4. Conclusions and Suggestion

It can be concluded then that the noodles substituted by *Moringa oleifera* is able to increase the productivity of breast milk of female rats. In this case, the sautéed processing method has given the highest lactagogum effect.

Several things that can be developed related to the result of this research are as follows: The use of *Moringa oleifera* leaves for the culinary of breastfeeding mothers still needs an application to daily dish in order to make it sustainably consumable. In addition, it also needs further socialization of *Moringa oliefera* related to the myth of people towards such foodstuff.

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