Various Formulations of Lepa as a Zinc-rich Food for Primary School Children

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Submission date: 03-Nov-2020 04:07PM (UTC+0800)
Submission ID: 1434823236
File name: 83-Article_Text-136-1-10-20200622.pdf (601.43K)
Word count: 3527
Character count: 17932

DOI: 10.17354/ijpphs/2016/29

Original Article

Various Formulations of Lepa as a Zinc-rich Food for Primary School Children

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ABSTRACT

Introduction: Nutrient that is responsible in the incidence of stunting is zinc. Lower intake of zinc can be attributed to the amount and quality of major food as well as low nutritional value in supplementary food that includes zinc. To improve the quality of food, it is needed to create the new formulations by adding certain nutritional content to enrich the food. Lepa is a traditional cake belongs to the people of rote and is preferred by children. The basic ingredients consisted of palm sugar water, cornstarch, and grated coconut. Lepa considered as poor in nutritional value. Formulations by adding Moringa leaf powder and anchovy flour, sesame and peanuts enrich the content of zinc in the cake.

Purpose: The purpose of this study was to analyze the level of preference and zinc content in Lepa.

Methods: This study applied experimental study design using completely randomized design with six repetitions. Ingredients used were palm sugar water, grated coconut, cornstarch, flour of Moringa leaves, anchovy flour, sesame, and peanuts. There were four formulations made: Control formula (F_0) = 42%: 37%: 21%. F_1 = 42%: 13%: 9%: 4%: 13%: 12%: 7%. F_2 = 42%: 10%: 10%: 6%: 13%: 12%: 7%. F_3 = 42%: 8%: 9%: 9%: 13%: 12%: 7%. Data concerning to organoleptic was processed using Kruskal–Wallis test to determine the differences among formulas and was described descriptively.

Results: An organoleptic test that consisted of limited panelist demonstrating the preference level of formulation for Lepa was between "somewhat liked" and "highly liked" (3.63-4.18). There was no difference in the level of preference between F_0, F_1, F_2, and F_3. The content of zinc indicated per 60 g were F_1 = 2.81 g, F_2 = 4.25 g, and F_3 = 3.65 g.

Conclusion: Lepa can be used as supplementary food which is rich in zinc.

Key words: Lepa, Rote, Supplementary food

INTRODUCTION

One of the unfinished nutritional problems in school children is stunted.[1] The prevalence of stunting in primary school children (6-12 years) in 2010 was 35% and was classified as "high."[2] One of the direct causes of stunting is due to a lack of energy and protein in long term.[3] Besides the lack of energy and protein, another nutrient that is responsible in the incidence of stunting is zinc.[4] The same report that the cause of malnutrition in Africa was due to micronutrient deficiencies, zinc included.[5] In Thailand reported, the incidence of stunting is associated with a lack of energy intake, protein and several micronutrients such as calcium, phosphorus, iron, Vitamin A, and zinc. Macro and micronutrients deficiencies cause a decrease in linear growth.[6] In Lombok Island, Indonesia found that child stunting experienced deficit intake of zinc (<70%).[7] The cause of the lack of nutrients in food is due to inadequate quantity and quality of the major food and supplementary food as well as less varied and low nutritional value foods consumed.[8] To meet the nutritional needs of school children, the government implemented supplementary food program (Indonesian: Pemberian Makanan tambahan). Supplementary food must be nutritious, balanced and varied, and preferably taken from local food or local ingredients.[9] The provision of supplementary food to primary school children should meet nutritional requirements which are minimum of 10-15% of recommended dietary allowance (RDA).[10]

Lepa is a traditional cake belongs to the people of Rote and is widely preferred by children and found in many. Lepa

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Submission: 05-2016; Peer Review: 06-2016; Acceptance: 07-2016; Publication: 08-2016

cake contains low of zinc since made only of palm sugar water (*Borassus flabellifer*), coconut (*Cocos nucifera*), and cornstarch (*Zea mays*) which are poor sources of zinc. The content of zinc in the cake is only reached 2.14% of the nutritional value required for being a supplementary food and fulfills only 4.8-6.11% of nutritional adequacy for primary school children.[11] Formulation with Moringa leaf powder (*Moringa oleifera*), anchovy flour (*Stolephorus* sp.), sesame (*Sesamum indicum*), and peanut (*Arachis hypogaea*) increases the content of zinc on the cake. The purpose of this study was to determine the level of preference and zinc content of Lepa that has been formulated.

METHODS

Study Design

This study applied experimental design of study using completely randomized design with six repetitions. This study carried out formulations for Lepa with the addition of Moringa leaf powder, anchovy flour, sesame, and peanuts.

Location and Time

All process that includes making Moringa leaf powder and anchovy flour, making Lepa, and analyzing the zinc levels were conducted at Nutrition Laboratory in Public Health Faculty Airlangga University, Surabaya. Organoleptic tests with limited panelist were conducted to four lecturers from the Department of Health Nutrition in Public Health Faculty Airlangga University, Surabaya, who are the expertise in organoleptic, food and nutrition. The study was conducted from February to June 2016.

Analysis of Nutritional Content

Analysis of zinc content was done using zinc method of analysis, SNI 6989.7.2009.

Tools

Tools used for making Moringa leaf powder and anchovy flour were: 100 mesh sieve, oven, blender, griddle and digital scales. Tools used for making Lepa were: Frying pan, spatula, cake molder, and gas stoves.

Ingredients

Ingredients selected for making Lepa contains a high level of zinc, excluding the basic ingredients; cornstarch, coconut, and palm sugar water.

1. Flour leaves of Moringa (*M. oleifera*): 1.3 mg of zinc
2. Anchovy flour (*Stolephorus* sp.): 5.8 mg of zinc
3. Cornstarch (*Z. mays*): 1.8 mg of zinc
4. Grated coconut (*C. nucifera*) providing aroma and savory taste
5. Sesame (*S. indicum*): 7.8 mg of zinc
6. Peanut (*A. hypogaea*) 3.3 mg of zinc
7. Palm sugar water (*B. flabellifer*) as binder.

Preparation

Moringa leaf powder: Sort Moringa leaves, wash in flowing water, blanch at a temperature of 90-100°C for 10-15 min, remove and drain for several hours, then dry using the oven with a temperature of 60°C for 6-8 h to make sure the powder was properly dried. Finally, sift the powder using a 100 mesh sieve. To make anchovy flour: Soak the anchovy for about 3 h, wash and boil in 80-90°C temperature for about 30-60 min, drain and dry at 100°C for 6 h till properly dried then sift using a 100 mesh sieve. To make cornstarch: Sort the corn seeds, roast until golden-or brown-colored, mill into powder and sift with a 100 mesh sieve. Roast grated coconut, sesame, and peanuts separately until browned-colored and fragrant. Finally, blend the peanut.

Method for Processing Lepa

Put in toasted coconut, cornstarch, Moringa leaves powder, anchovy flour and sesame in one bowl and mixed thoroughly. Cook the palm sugar water until it thickens (1.5-2.5 min) with a temperature of 95°C-105°C and can be higher when cooking Lepa cake for up to 120°C. Reduce the heat, put mixed ingredients, stir well. Stir constantly, until cooked and thickened (and mixed) for 3-6 min. Mold using cake molder and pack when ready.

Processing and Data Analysis

Organoleptic data were analyzed using Kruskal–Wallis test to determine the differences in treatment between groups, while if differences existed then being tested using the Mann-Whitney U-test. The zinc content was processed using Microsoft Excel 2007. Data were being presented through tables and were being analyzed descriptively.

RESULTS

Formulations for Lepa

The formulation was done by selecting zinc-rich ingredients, the results of the formulation presented in Table 1.

The addition of Moringa leaf powder in F_1, F_2, and F_3 was 4%, 6%, and 9%, respectively. While the addition of anchovy flour, sesame and peanut were 13%, 12% and 7%, respectively, in each formulation.

Hedonic Test Results

Color

The results of the organoleptic test with limited panelists regarding the color of Lepa were presented in Figure 1.

Figure 1 presented that the highest ratings were F_3 with an average value of 4.25 (liked), while the lowest ones were F_1 with an average value of 3.5 (somewhat liked).

Aroma

The results of the organoleptic test with limited panelists regarding to the aroma of Lepa were presented in Figure 2.

Figure 2 presented that most panelists preferred F_1 and F_3 with average values of 4.25 (liked), the lowest ratings was F_2 with an average value of 3.75 (somewhat liked).

Texture

The results of the organoleptic test with limited panelists regarding the texture Lepa were presented in Figure 3.

Table 1: Formulations for making Lepa

Ingredients	F_0%	F_1%	F_2%	F_3%
Palm sugar water	42	42	42	42
Coconut	37	13	10	8
Cornstarch	21	9	10	9
Moringa leaf powder	0	4	6	9
Anchovy powder	0	13	13	13
Sesame	0	12	12	12
Peanut	0	7	7	7
Sum	100	100	100	100

Figure 3 presented that the panelists provided the highest ratings to F_3 with an average value of 4.25 (liked), and the lowest ones were F_1 with an average value of 3 (somewhat liked).

Taste

The results of the organoleptic test with limited panelists regarding to the taste of Lepa were presented in Figure 4.

Figure 4 presented that the panelists provided the highest rating to F_2 with an average value of 4.5 (liked), while the lowest ratings were F_1 with an average value of 3.75 (somewhat liked).

Acceptability

The average ratings for acceptability of Lepa were presented in Table 2.

Table 2 presented that the panelists provided the highest ratings to F_5 with an average value of 4.1 (liked) and the lowest ones were F_2 with an average value of 3.6 (somewhat liked).

Figure 5 presented that in terms of color, aroma, texture and taste, panelists preferred F_3 with ingredients of palm sugar water 42%, grated coconut 10%, cornstarch 10%, flour Moringa leaves 6%, anchovy flour 13%, sesame 12% and 7% peanuts.

The zinc content

The zinc content of Lepa was presented in Table 3.

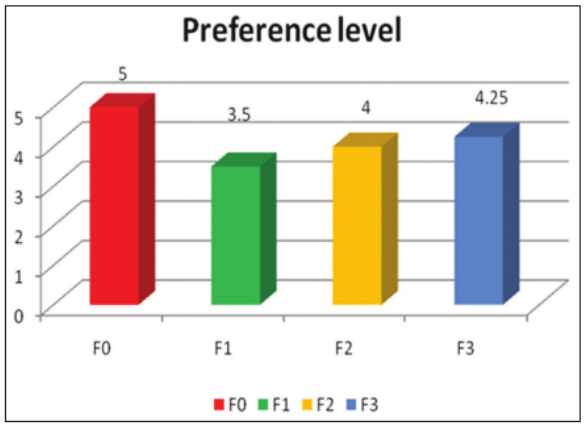

Figure 1: Preference level of Lepa regarding to the color

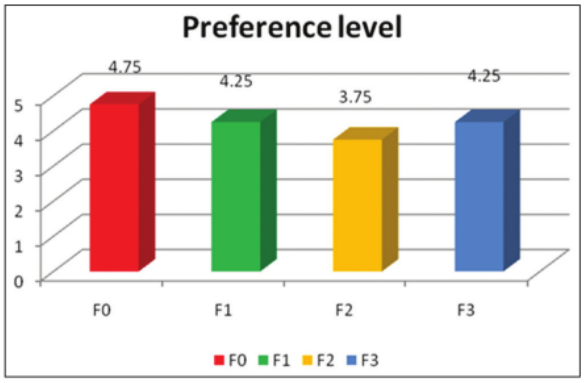

Figure 2: Preference level of Lepa regarding to the aroma

Table 3 presented that the highest content of zinc was in F_2; as much as 4.25 mg, followed by F_3 as the second; as much as 3.65 mg followed on the third by F_1 as much as 2.81 mg while F_0 was the lowest with only 1.1 mg.

DISCUSSION

The formulation of Lepa was intended to increase the content of zinc by adding zinc-rich food ingredients. Moringa leaf powder is a nutrient-rich food source. Moringa leaf powder has a high content of zinc (1.3 mg).[12] Besides, according to some studies Moringa leaves are often being used to address the incidence of malnutrition because of its richness in nutrients and active compounds. Moringa leaves have been used in several African countries to tackle malnutrition in children, pregnant and lactating mothers.[5] By adding 7 g of Moringa leaf powder into toddler foods every day for 2 months, can increase the child's height. Further explanation, that the average height of children increased by 3.79 cm than the previous ones.[13] Anchovy also has a high content of zinc (5.8 mg).[11] Children who are provided with anchovy based-biscuit had average height growth higher than the control group.[14] Likewise, sesame and peanuts have fairly high content of zinc with 7.8 mg and 3.3 mg, respectively.[11]

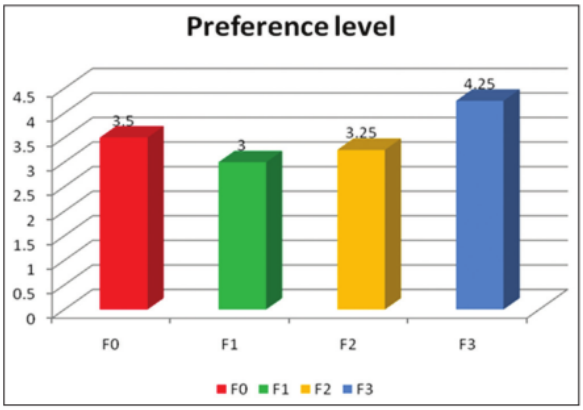

Figure 3: Preference levels of Lepa regarding to the texture

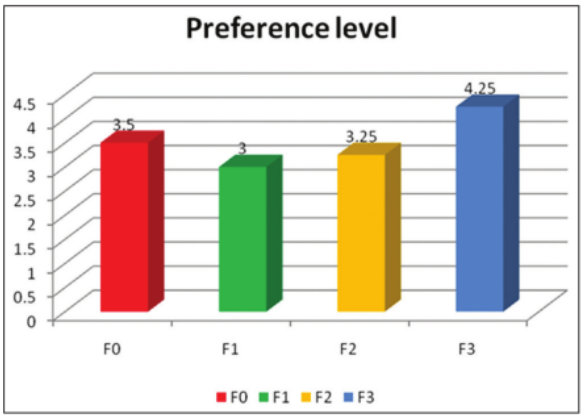

Figure 4: Preference level of Lepa regarding to the taste of Lepa

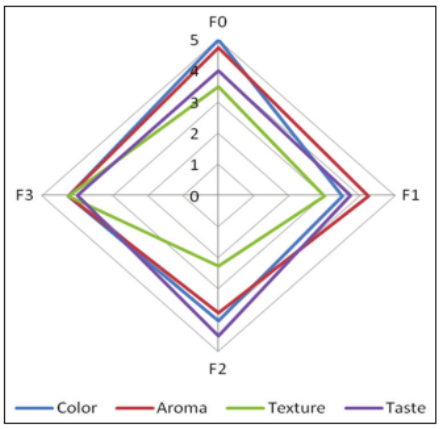

Figure 5: Preference level of the panelists to Lepa

Table 2: Average level of acceptability of Lepa

Formulation	Organoleptic scoring of Lepa					
	Color	Aroma	Texture	Taste	Total	Average
F_0	5.00	4.75	3.50	4.00	17.25	4.30
F_1	3.50	4.25	3.00	3.75	14.50	3.60
F_2	4.00	3.75	2.25	4.50	14.50	3.60
F_3	4.25	4.25	4.25	4.00	16.75	4.10

Table 3: The zinc content of Lepa per 60 g

Formulation	Zinc (mg)
F_0	1.12
F_1	2.81
F_2	4.25
F_3	3.65

Characteristics of Lepa

Color

Formula used in F_1, F_2, and F_3 produce darker green appearance. F_3 used 9% Moringa powder and had a darker green color than F_2 (6%). F_1 formula used 4% Moringa powder and had brighter colors than both F_2 and F_3. The more Moringa leaf powder used, the darker the color of the cake. The green color in Moringa leaves comes from the chlorophyll. Blanching process causes the color changes to dark green or yellowish-green due to chlorophyll content in leaves degraded by heat.[15] In the control formula (F_0), the cake appeared brownish to yellowish because of no Moringa leaf powder used. The brown color comes from heating palm sugar water which produces sticky and brown-colored caramel hence the effect on the cake's appearance.[16]

Aroma

F_1, F_2, and F_3 were dominated by the aroma of sesame which is produced from pyrazine compounds contained in sesame while roasting triggers evaporation of pyrazine compounds.[17] F_0 was dominated by the aroma of toasted coconut, derived from bounded fatty acids in the form of ester which triggers distinctive coconut aroma.[18]

Texture

In F_1, F_2 and F_3 produced more solid texture. The proportion of Moringa leaf powder as much as 4%, 6%, and 9% provides an effect on the texture of the cake. The more Moringa leaf powder is used; the more solid texture obtained.[19]

Taste

The flavors derived from palm sugar water which contains sucrose. Sucrose provides the sweet taste.[20] In F_1, F_2 and F_3, the addition of Moringa leaf powder and anchovy flour does not provide fishy nor unpleasant taste/smell. Blanching process lowers the levels of phytate in Moringa leaf that causes unpleasant odor. While fishy smell was not noticeable because of being covered with sesame and tea-like flavor from Moringa leaves. For F_0, the sweetness was mixed with savory flavors derived from coconuts.

Acceptability

The results of the organoleptic test with limited panelists toward 4 formulations indicated that the color, aroma, texture and taste of the cake were acceptable. For the texture and flavor, F_2 and F_3 were being more preferred by the panelists compared with the control. This was confirmed by Kruskal tests indicating that there was no difference in the level of preference among the treatments in terms of color, aroma, texture and taste of Lepa. This also means that the formulation of Lepa using F_1, F_2, and F_3 formulations do not provide a significant influence on the level of preference of color, aroma, texture and taste of the cake.

Nutritional value

Table 3 shows that the F_1, F_2, and F_3 formulations have a higher content of zinc and fulfill nutritional value required as supplementary food. The need for zinc for elementary school children aged 7-9 years can be fulfilled at 15.33-23.18%. Male children aged 10-12 years can be fulfilled with 12.04-18.21%, and female children aged 9-10 years can be fulfilled with 12.97-19.62%. Therefore, F_1, F_2, and F_3 as Lepa formulations can be used as zinc-rich supplementary food for elementary children.

The role of zinc in the growth process is that it is involved in the bioactivity of insulin-like growth factor 1 (IGF-1) on bone cells. Some studies have found that zinc plays a role in the work of IGF-1 and promotes the synthesis of endogenous IGF-1.[21] Growth occurs through cell division and requires the synthesis of DNA, RNA, and protein. Growth is regulated by hormones especially by growth hormone and IGF-1.[22]

CONCLUSION

Organoleptic of Lepa was being accepted by the panelists. Statistical analysis showed that Lepa formulations did not influence the preference level of the panelists.

The zinc content in all formula meets nutritional value required for being supplementary foods and fulfills the needs of the zinc as much as 12.04-23.18% for primary school children aged 7-12 years, both males and females.

Generally speaking, the formulations were being accepted by the panelists and were in compliance to nutritional value for being supplementary foods, and RDA therefore could be used as zinc-rich supplementary foods for elementary school children.

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HOW TO CITE THIS ARTICLE:
Karyantono O, Adi AC, Adriani M. Various Formulations of Lepa as a Zinc-rich Food for Primary School Children. Int J Prevent Public Health Sci 2016;2(2):18-22.

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PAGE 2

PAGE 3

PAGE 4

PAGE 5