Characteristics of Snack Bar “Banaris” from Fortified Non Cereal Flour as Emergency Food for Toddler

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Abstract. The objective of the research is the development of banaris bar products using flour-based of local food with FIR technology, that fulfill the economic, social-cultural, nutritional and health eligibility requirements as an alternative food emergency to support diversification national food because this product is needed in accordance with the adequacy of nutrients for the age group of nutrient-prone (infants and toddlers). fortification, testing product characteristics, packaging, shelf life testing, probiotic testing of Bifidobacterium sp and Lactobacillus sp and testing of serum retinol concentrations in children under five year. The effect of giving Banaris bar products gives positive results on increasing subject height. The provision of Banaris bar products containing prebiotics can stimulate the growth of the Lactobacillus sp population in the toddler's digestive tract in the treatment group compared to the control group toddlers.. The level of crispness, elasticity, stickiness, compactness and fragility of the banaris bar is lower than the regular bar snack. The packaging used is aluminum foil primary packaging and secondary packaging, namely carton. The packaging consists of 3 variants, namely packaging for six pieces with a size of 10.5 x 8 x 3.5 cm, packing for 9 pieces with a size of 15 x 8 x 3.5 cm and packaging for 15 pieces with a size of 15 x 13 x 3.5 cm. Banaris bar products have a shelf life of 10 months.

1. Introduction

Indonesia is still facing nutritional problems, one of which is shown by the high prevalence of short children (stunting). Basic Health Research Data, 2010 shows that 17.16% of toddlers in Indonesia have below-standard height that is set or stunted. In West Java Province the number of toddlers who experienced stunting was 17.1% while in the City of Cimahi it was 17.8% [1]. 'Short child' is not only a physical problem, but illustrates the existence of chronic nutritional problems suffered by children. This problem arises as a result of long-standing conditions such as poverty, inappropriate parenting behavior, often suffering from illness. Damage caused by 'short children' cannot be changed (irreversible).

The development of Banaris bar products for infants and toddlers needs to be complemented (fortified) by adding various micronutrients that can increase the body's immune system and physical growth and intelligence Levels of fortification of omega 3 were 198 mg / 100 grams and omega 6 1.9 grams / 100 grams. In addition to fortification with omega 3 and 6, Banaris bar products need to be fortified with as much as 5 mg / 100 grams of zinc and iron as much as 6 mg / 100 grams of flour. Zinc intake plays a role in forming and maintaining bone and tooth density while iron plays a role in preventing iron deficiency anemia.
Shelf life or expiration is a parameter of product durability during storage [2]. One obstacle that is always faced by industry in estimating the shelf life of a product is a matter of time, because for producers this will affect the launch schedule of a food product. Therefore, the method of estimating the shelf life that is chosen must be the fastest, easiest method, providing the right results, and in accordance with the characteristics of the food product concerned. Testing of Banaris bar products uses the acceleration method or Accelerated Shelf Life Testing (ASLT) with various types of packaging, namely aluminum foil and HDPE plastic [3].

The objective of the research is the development of banaris bar products using flour-based local food with FIR technology, that fulfill the economic, social-cultural, nutritional and health eligibility requirements as an alternative food emergency to support diversification national food because this product is needed in accordance with the adequacy of nutrients for the age group of nutrient-prone (infants and toddlers). Fortification, testing product characteristics, packaging, shelf life testing, probiotic testing of Bifidobacterium sp and Lactobacillus sp and testing of serum retinol concentrations in children under five year.

2. Methodology

2.1 Banaris Bar Product Development
Sweet potato flour making with FIR technology was carried out at the Laboratory of Postharvest Agriculture Research and Development Center? using a drying oven with FIR radiation which could absorb FIR energy at a wavelength range of 2.5 μm. Sweet potato drying is more efficient because of the mechanism that occurs electromagnetically with vibrations or molecular vibrations accompanied by rotation of atoms and molecules during FIR radiation. The advantage of FIR technology is that it prevents minimal changes in beta carotene volatile substances (Volatile Reducing Substance). To reduce the effect of flatulence, before making sweet potato flour with FIR, sweet potatoes were fermented with Lactobacillus bulgaricus Lactic Acid Bacteria (BAL) with a concentration of 0.1% soaked for 12 hours. Testing of beta carotene levels was carried out at the Laboratory of Agricultural Postharvest Research and Development Center ?? using the HPLC method.

2.2 Fortification With Omega 3, 6, Zinc and Iron Banaris Bar
Fortification with 98 mg / 100 grams of omega 3 and 1.9 grams / 100 grams of omega 6, 5 mg / 100 grams of zinc (zinc oxide) and 6 mg / 100 grams of iron (Ferrous sulfate).

2.3 Testing the Characteristics of Banaris Bar Texture
Testing of Banaris bar texture characteristics carried out in the Central Laboratory is carried out namely hardness (hardness), springiness (elasticity), adhesiveness (stickiness), cohesiveness (cohesiveness), and fractubility (fragility).

2.4 Banaris Bar Packaging and Age Testing
The Banaris bar packaging design is carried out in the packaging house of the West Java Province Industrial Office. The packaging used is aluminum foil primary packaging and carton secondary packaging. Estimating shelf life based on the critical water content (Labuza) approach can be calculated using the Labuza equation:

$$\theta = \frac{[\ln(me-mo)/(me-mc)]}{[k/x*A/Ws*Po/b]}$$

$\theta$ = The time required in the packaged product to move from the initial water content to the critical water content or the estimated shelf life (day = 24 hours)
me = Product balance water content (g H2O / g solids)
mo = Product initial moisture content (g H2O / g solid)
b = Slope of the isothermal sorption curve
cmp = critical moisture content (g H2O / g solids)
k / x = steam permeability constant of bottled water (g / m².day.mmHg)
A = Packaging surface area (m²)
Ws = the dry weight of the product in the package (g solid)
Po = saturated vapor pressure (mmHg)

Determination of critical water content begins with storing baniaris at room temperature for several hours until the product is very sluggish. Every hour sampling was taken and water content, crispness (texture) and organoleptic properties of the texture were analyzed. Moisture content was measured based on SNI 01-2891-1992 while crispness was measured with a texture analyzer. Organoleptic texture test was carried out with a 1-7 test scale. The relationship is expressed in the linear regression equation.

The value of crispness when critical water content is reached can also be obtained from the regression equation which states the relationship of preference score with crispness value, i.e. when the favorite score is 3. Besides determining the linear regression relationship between crispness and preference scores above, also determined the percentage decrease in crispness until critical water content is reached based on the following formula.

\[
\text{% decrease} = \frac{\text{(initial crispness} - \text{critical crispness}) \times 100\%}{\text{initial crispness}}
\]

2.5 Determination of Physical Characteristics
Determination of the isothermal sorption curve begins with the manufacture of saturated salt solutions which are used to adjust the RH of the room (desiccator). The salt used in this study is MgCl₂, NaBr, NaCl, KCl, and KNO₃. Packaging Permeability Determination refer to ASTM, F1249-01. Determination of saturated water vapor table refer to Labuza, 1982, and determination of Banaris Age refer to Labuza, 1982. The shelf life of baniaris products is calculated using two approaches namely sorption curve approach.

2.6 Testing the Efficacy of Banaris Bar Products in Toddlers
Design Efficacy testing by therapeutic effect is used a single blind randomized treatment control groups experimental design. The design of this study compared the initial data of the population of Bifidobacterium sp and Lactobacillus sp before intervention and the final data of Bifidobacterium sp and Lactobacillus sp after intervention and compared the population of Bifidobacterium sp and Lactobacillus sp in the intervention group and the control group.

2.7 Data Processing and Analysis
Data analysis was conducted including univariate analysis to know the distribution of data, bivariate analysis to determine the relationship between variables. Prior to statistical analysis, for numerical data, normality data were tested using Kolmogorov Smirnov to see data distribution because the number of samples was more than 50 people. Bivariate analysis was conducted to determine differences in the population of Bifidobacterium sp and Lactobacillus sp and serum retinol concentrations before and after the intervention, if the data were normally distributed the analysis was performed using a dependent t statistical test, but if the data was not normally distributed, non-parametric Wilcoxon Sign Rank Test was analyzed. To control the food intake of children under five, food consumption was measured using the SFFQ (Semiquantitative Food Frequency Questionnaire) method so that the amount of nutritional intake was consumed during the last 2 weeks.

3. Results and Discussion
3.1 Level of beta carotene sweet potato flour with FIR technology
Based on the results of testing the levels of beta-carotene sweet potato flour with FIR dryers and ordinary dryers obtained results there were differences in carotene beta levels by 60%. Sweet potato flour produced by the FIR process has higher levels of beta carotene. The use of a drying oven with FIR radiation can absorb FIR energy at a wavelength range of 2.5 μm. Sweet potato drying is more efficient
because of the mechanism that occurs electromagnetically with vibrations or molecular vibrations accompanied by rotation of atoms and molecules during FIR radiation. The advantage of FIR technology is that it prevents minimal changes in beta carotene volatile substances (Volatile Reducing Substance).

The orange sweet potato used in this study has excellent potential in the high content of beta carotene (provitamin A) and has many benefits for the body, because in addition to being able to meet the needs of vitamin A it also functions as an antioxidant to fight free radicals in the body. The presence of double bonds in the chemical structure of beta carotene causes flour to be very sensitive to oxidation reactions when exposed to air (O₂), light, metal, peroxide, and heat during the production process and its applications. The shrinking content of beta carotene during the flour processing will shrink further.

3.2 Banaris bar processing
Interventions in giving Banaris bars to toddlers The intervention activities for Banaris bar were carried out for 6 weeks consisting of preparation of tools and materials for 1 week, screening of 1 week sample, Bifidobacterium population sp and Lactobacillus sp and serum retinol concentrations before and after intervention. To determine differences in nutritional status, the number of Bifidobacterium sp and Lactobacillus sp populations and serum retinol concentrations of the intervention and control groups were carried out by independent t analysis. 4.4.2 Results of Examination of Toddler Nutritional Status
The effect of giving Banaris bar to the nutritional status of toddlers in the Height Index according to Age (TB / U) or stunting is presented in Figure 1.

![Figure 1. The delta Z score of the nutritional status of the TB/U index in the intervention and control groups](image)

In Figure 1 shows the results that the change in TB / U z score in the intervention group was higher than the control group with a mean delta z score of TB / U in the intervention group of 0.06 and in the control group of 0.02 (p = 0.062). This means that giving banaris bars to subjects who experience malnutrition has a tendency to increase height. The average intake of Banaris bar products consumed by the subjects was 82%. Nutrient content in Banaris bar products in the form of energy, protein, iron and zinc can increase height in the subject.

The crispness of the banaris bar is lower than the control bar snack. This is because the Banaris bar products are intended specifically for infants and toddlers so that the crispness level is adjusted to the conditions of infants and toddlers. Hardness is used to describe the inertness of cake crumbs. Hardness value is the amount of force needed to reach the peak during compression. Springiness (elasticity) is the level that can be reached by a food between the first and second bites. The elasticity produced by Banaris bar in the six treatments is below the value of the snack bar control because the Banaris bar is an inelastic product.
3.3 Banaris Bar Packaging and Estimated Shelf Life

Banaris bar packaging is done at the Bandung Ministry of Industry’s packaging house. The packaging used is aluminum foil primary packaging and secondary packaging, namely carton. The packaging consists of 3 variants, namely packaging for six pieces with a size of 10.5 x 8 x 3.5 cm, packing for 9 pieces with a size of 15 x 8 x 3.5 cm and packaging for 15 pieces with a size of 15 x 13 x 3.5 cm. Estimation of shelf life using ASLT method with critical water content approach. The initial moisture content of Banaris bar = 5.18% (0.0518). The water content relationship curve and the mean crispness score, presented in Figure 2 and the crisp value relationship curve and the mean crispness score presented in Figure 3.

![Figure 2. Curve relationship of crisp value and mean crispness score](image1)

![Figure 3. Curve relationship of crisp value and mean crispness score](image2)

![Figure 4. Sorption of the isothermal curve of the Banaris bar](image3)
3.4 Techno Economic Analysis of Banaris bar products.
Banaris bar products are potential products to be developed as emergency food alternatives. The raw material used in making Banaris bars is easy to obtain because it uses local Indonesian food ingredients. Banaris bar products have been tested by consumer panelists stating 93.3% likes. Banaris bars can be developed for products that can be consumed by the public.

4. Conclusions
The addition of omega 3 to Banaris bar products for the age group of 4 - 6 years has fulfilled the recommended nutritional adequacy (> 70% RDA), as well as the addition of zinc and iron, but for the addition of omega 6 is still below the recommended nutritional adequacy. The effect of giving Banaris bar products gives positive results on increasing subject height. The provision of Banaris bar products containing prebiotics can stimulate the growth of the Lactobacillus sp population in the toddler's digestive tract in the treatment group compared to the control group toddlers. The level of crispness, elasticity, stickiness, compactness and fragility of the banaris bar is lower than the regular bar snack. The packaging used is aluminum foil primary packaging and secondary packaging, namely carton. The packaging consists of 3 variants, namely packaging for six pieces with a size of 10.5 x 8 x 3.5 cm, packing for 9 pieces with a size of 15 x 8 x 3.5 cm and packaging for 15 pieces with a size of 15 x 13 x 3.5 cm. Banaris bar products have a shelf life of 10 months.

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