Conference Paper

Creating Value of Agro-Industrial Wastes

Nafis Khuriyati, Didik Purwadi, Ibnu Wahid F.A., Kartika Fitriani, and I Putu Eldwin I.D.

Department of Agro-Industrial Technology, Faculty of Agricultural Technology, Gadjah Mada University, Jl. Flora No.1 Bulaksumur 55281, Indonesia

Abstract

Food processing industry as a kind of agro-industry generates a large amount of waste. These wastes have potential since the contain vitamins, mineral nutrients, and other compounds with functional properties. This paper addresses the wastes generated from processing jackfruit and tuna industries. It was observed that the product development is an important role for creating the value of agro-industrial wastes. The wastes can be used as valuable resources for food production. Jackfruit seed and tuna skin were processed into nutritional foods.

Keywords: Agro-Industrial Wastes; Food; Product Development; Value

Corresponding Author
Nafis Khuriyati
nafis.khuriyati@ugm.ac.id

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INTRODUCTION

Indonesia is located in the tropics that has high biodiversity derived from plants and animals. Fruit, vegetable, and fish processing industry are national priority industry in the group of the food industry. These industries transform biological materials into valuable food. On the other hand, the food industries generate waste in the form of solid, liquid and gas. The wastes emerge from various sources, such as impurities contained in the raw materials that must be separated from the production process and disposed of as waste. Furthermore, the waste can also be derived from the main component of raw materials that cannot be transformed into a product or derived from the main component material becomes a by-product due to the transformation process does not take place at the optimum condition.

Raw material characteristics of food industries make waste generated contains a lot of organic material such as protein, oil, carbohydrate, fat, etc. The waste also has the high values of BOD, COD, and suspended solids [7]. Due to the high content of organic material, agro-industrial waste may cause pollution if not managed properly. In contrast, the agro-industrial waste can be used as valuable resources because they

contain useful nutrients. Therefore, it is need the process to utilize the agro-industrial wastes.

Waste management uses the 3R hierarchy (Reduce, Reuse, Recycle) is one of the solutions to preserve the environment. Recycling is the process to make a discarded material into a new product with the aim of preventing the waste, reducing the use of raw materials, reduce energy usage, and reduce pollution, land degradation, and greenhouse gas emissions. The new product resulting from recycling should have superior characteristics thus providing added value for consumers. The success of new product development is largely determined by the ability of developers to understand the wants and needs of the consumers and market conditions [5]. Prihasti et al [9] have been successfully utilizing banana skin as a substitute for coconut water in the manufacture of nata, a product developed called the nata de banana skin. The objective of the research is to develop new food product from the agro-industrial wastes that deliver superior value to the consumer.

MATERIALS AND METHOD

Materials

Two kinds of agro-industrial waste used in the study were the jackfruit seeds and skin of tuna fish. They were collected from jackfruit chip and fillet tuna fish industries. The jackfruit (Artocarpus heterophyllus) is a versatile plant, the fruit is used for food, the leaves are for feed, and the stems are for a building material. From all parts of jackfruit, jackfruit seeds are underutilized.

Percentage of jackfruit seed is 6.87-10.4% of the fruit [1]. Tuna (Thunnus spp) is one of Indonesia's main export commodity. High nutrient content in tuna increasing world demand every year. Tuna fillet processing generated skin waste approximately 3% of the total fish weight.

Method

New product development process requires a technique or method that supports the success of new products in the market. Value engineering is a systematic method to identify the function of an object or project by giving a value to each existing functions and developed a number of alternatives that allow the achievement of these functions with minimum cost. The studies that implementing value engineering for the

product development were conducted by Khuriyati et al [6] in the development of the tomato jam for industrial product and Ibusuki et al [4] in an automotive company. Value engineering consists of three stages, which are:

Information gathering

The main source of new product ideas is markets or technologies that already exist. The initial stage of product development is gathering the information of consumer needs for the functions or attributes of the product. The information gathering was conducted on two things, the waste characteristics and consumer needs. Data were collected from literatures and consumer survey, respectively.

Alternative generation (Creation)

In this stage, the various alternative ways of meeting requirements were generated. It combined the characteristic of the agro-industrial waste to consumer needs through food product development. Value of agro-industrial waste created in this stage. Product value is determined on how the product can perform its function to meet the needs of consumer.

Evaluation

To meet the customer needs, a variety of alternative product is generated in this second stage. It combined the characteristic of the agro-industrial waste to consumer needs through food product development. The value of agro-industrial waste created at this stage. Product value is determined on how the product can perform its function to meet the needs of the consumer.

RESULTS AND DISCUSSION

Jackfruit seed

Information gathering

Seeds of jackfruit are edible and rich in vitamin B1, B2, and starch but low in calcium and iron. They are similar to chestnuts, but less moist, less starchy, less sweet and a

Table 1: The Nutritive Value of Jackfruit Seed.

Component (unit)	Value
Water (%)	57.6
Energy (calorie)	143.0
Protein (g)	5.6
Fat (g)	0.6
Carbohydrate total (g)	34.9
Fiber (g)	1.4
Ash (g)	1.3
Calcium (g)	23.0
Phosphor (mg)	80.0
Iron (mg)	0.8
Sodium (mg)	3.0
Potassium (mg)	673.0
Vitamin A (I.U)	-
Thiamine (mg)	0.22
Riboflavin (mg)	0.06
Niacin (mg)	0.6
Ascorbic acid (mg)	10.0
Source: De Leon *et al.* [2]	

little more savory/acidic, with a hint of jackfruit notes [8]. The seeds are usually boiled and eaten as a snack. The nutritive value of jackfruit seed is shown in Table 1.

The advantage of jackfruit seeds is the high content of carbohydrates and protein. This seed flour can serve as a substitute for wheat flour. Thus, jackfruit seeds can be used as a food for calorie source.

The consumer survey shows that they want jackfruit seed that is processed into the form of chip snack. Sequentially, from the most important, the quality attributes of chips that emphasis by the consumer are flavor, nutrition fact, crispness, shelf life, aroma, shape, and packaging. These attributes determine the performance of products which in turn will determine the product value.

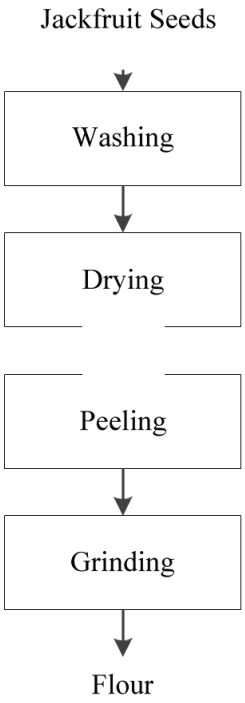

Figure 1: Jackfruit-seed Flour Processing.

Creation

Creation stage is undertaken to generate the product development concept. Alternative concepts of chips were generated by a variation in material composition (the ratio between seed flour and wheat flour) and the kind of additional material. Additional material was needed to meet the consumer needs of nutrition and flavor. Honey and garlic were selected as additional materials. Honey is a natural liquid, sweet, and contain nutrients while garlic is antioxidant.

The process for recycling the jackfruit seed into flour and further process for producing chips are shown in Fig. 1 and Fig. 2.

Evaluation

Sensory test conducted on two alternative products namely chips with the addition of honey and chips with the addition of garlic. Sensory testing included aroma, flavor, crispness, and shape. The results showed that the two alternative products have a good value for all the sensory criteria, except for product with additional garlic is nearly very good. Generally, chips with the addition of garlic are more acceptable than the honey (Table 2).

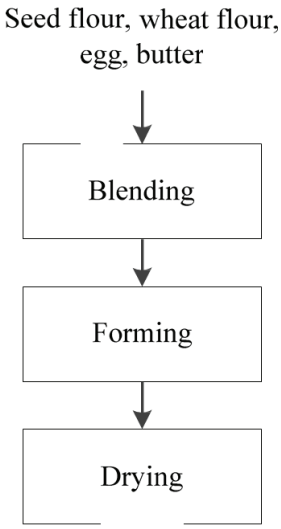

Figure 2: Jackfruit-seed Chips Processing.

Chips

TABLE 2: Sensory test of Jackfruit-seed Chips.

Sensory	Additional Garlic	Additional Honey
Aroma	3.10	2.97
Flavor	3.10	3.13
Crispness	3.73	3.03
Shape	3.07	3.03
1=very bad, 2=bad, 3=good, 4=very good		

Tuna skin

Information gathering

Tuna fish skin has the potential to be processed into gelatin or tanned. According to Shyin [10], some of the fish skin are able to be processed into gelatin, such as tuna and shark skin, but the gelatin quality from shark skin better than the tuna's. Tuna skin can be tanned, but less aesthetic value in terms of skin pattern. Tuna skin is considered to be high in protein and fat (Table 3). The tuna skin can serve as a substitute for fish in a cracker. Cracker is a popular snack in Indonesia, especially as a complement to a variety of foods. It is made from cassava starch mixed with shrimp or fish as a flavor enhancer.

Crackers produced from fish skin must have the quality attributes that generally exist on crackers products. In this study, the determination of the quality attributes based on the research conducted by Ibnu et al [3] which are aroma, texture, and color.

Table 3: The Nutritive Value of Tuna Skin.

Component	Value
Protein (%)	20.5
Water (%)	56.5
Fat (%)	18.3
Ash (%)	4.39
Source: Shyni [10]	

Table 4: Sensory test of Fish Skin and Fish Crackers.

Sensory test	Tuna skin Cracker	Fish Cracker
Aroma	6	5
Flavor	6	6
Color	5	6
1=dislike very much, 2=dislike, 3=rather dislike, 4=rather like, 5=like, 6=like very much		

Creation

At this stage, the concept development was based on a composition ratio of flour with fish skin (1:2, 1:4, 1:6) and crackers drying method used (sun drying & cabinet dryer). Fig. 3 shows how tuna skin crackers are processed.

Evaluation

From some of the concepts developed, determined the best concept based on the results of the sensory test. The selected concept is a cracker with a composition ratio of tuna fish skin and tapioca flour of 1:2 and dried using a dryer cabinet. The sensory test indicates that the Tuna skin crackers meet sensory criteria such as fish crackers (Table 4).

CONCLUSSIONS

Agro-industrial wastes that have almost no economic value could be transformed into valuable resources. Through a series stages of value engineering, jackfruit seeds processed into flour for making chips, substitute the wheat flour. Additionally, the tuna skin also substitutes fish in the producing of crackers. Food produced from processed

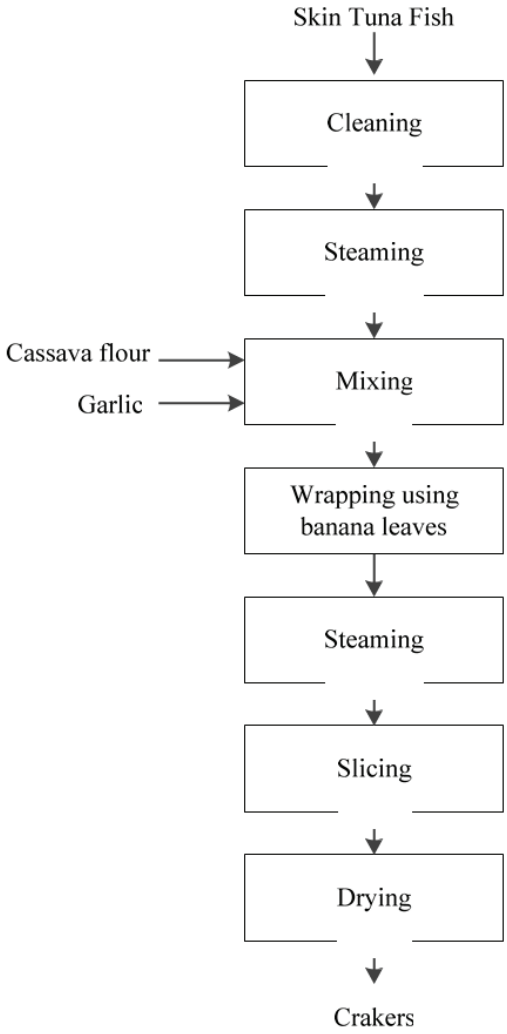

Figure 3: Skin Fish Cracker Processing.

agro-industrial wastes are able to meet the needs of consumers on the sensory criteria. For further research is needed costs benefits analysis of creating the value of agro-industrial wastes.

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