Formulation of High Protein Albumin Karageenan for Malnourished Children

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Abstract. Malnourished children may have compromised immune system. Snake head fish was well known for its albumin as a potential immunomodulator by enhancing both humoral and cellular immune response. This research aim to develop snakehead fish albumin into karageenan that can be accepted. We used snakehead fish extract as albumin source, strawberry pure to enhance sensory preference, gelatin and carrageenan as gelling agent, sucrose and honey as sweetener. Proximate and sensory preference parameters were evaluated to know the best formula. There is an increase in protein and ash content along with the increase in the concentration of snakehead fish extract. In terms of sensory profile, the acceptable snakehead fish candy gummies are P1 texture. So it is concluded that snakehead fish extract is possible to be developed into karageenan but further optimization is needed to obtain a more optimal formula and longer shelf life.

Keywords: Channa Striata, Food Formulation, Functional Food, Gummies.

1 Introduction

The number of malnourished toddlers continues to increase year after year. The high number of toddlers experiencing malnutrition is feared to be a manifestation of high stunting rates in the coming years. Malnutrition is an acute nutritional problem, while stunting is a chronic nutritional problem that occurs due to persistent macro and micronutrient deficiencies over a long period of time [1, 2]. Chronic malnutrition affects immune-mediated cells and antibody production in children, increasing the risk of infectious diseases[3, 4]. Infectious diseases in toddlers trigger a decrease in appetite, leading to low intake. One source of nutrients that plays a role in the formation of antibodies to boost the immune system is protein.

Snakehead fish is a freshwater fish rich in albumin, amino acids, Zn, Fe, Cu, and unsaturated fatty acids, which can act as immunomodulators [4], [5], [6]. Snakehead

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fish extract has been widely used as a functional food for cancer patients during chemotherapy, post-op patients, and patients with liver disorders [5, 6] It is administered in liquid form, such as drinks or capsules, which are difficult for children to accept due to its similarity to medicine and fishy odor[6–9]. Snakehead fish extract, high in albumin, has been empirically and scientifically proven to be a therapeutic support for patients to boost their immunity. Its antioxidant and essential amino acid content can increase cell activation and inhibit cytokines such as TNF-α and IL-5. Its immunomodulatory role, through its role in regulating cytokines and scavenging free radicals, can support the healing of malnutrition in inflammatory conditions. Studies have shown that administering snakehead fish extract can improve nutritional status and immune parameters such as albumin levels and reduce neutrophil and lymphocyte counts during inflammation in children and adults. [6, 8]

Strawberries are a favorite fruit for toddlers, rich in vitamin C and possessing a dominant flavor, aroma, and color. The combination of vitamin C in strawberries and sulfur-containing amino acids in snakehead fish extract can strengthen the endogenous antioxidant system to combat ROS produced by infection. Meanwhile, albumin, zinc, and unsaturated fatty acids can form antibodies to strengthen the immune system. Thus, nutrient intake from food can be focused on growth.

Gummy candy is known as a popular snack for children, but it is usually high in simple sugars, high in calories, and low in bioactive components. The formulation of snakehead fish extract combined with strawberries to create gummies is expected to increase toddler acceptance. The latest formulation of gummies candy fortified with plant extracts is organoleptically acceptable, low in calories, and has consumer acceptance [10, 11] The incorporation of Channa striata and strawberries in gummies could improve compliance and nutritional intake in malnourished children. Therefore, the aim of this research is to produce a snakehead fish extract gummies product with good nutritional content and acceptance.

2 Materials And Methods

Snakehead fish (*Channa striata*) extract was obtained from local supplier CV Striata (Singosari, Malang, Indonesia). Fresh strawberries were obtained from the organic farm NT Strawberry (Batu, Indonesia), granulated sugar or sucrose in the form of small white granules. Pure honey, with no added sweeteners or flavorings, carrageenan in the form of a fine, unflavored powder, and gelatin in powder form were used.

The process of making karageenan was mixing strawberries, granulated sugar and honey. The formulation is done based on the ratio of fish juice and strawberries (table 1). The mixture is stirred until homogeneous. Carrageenan and gelatin are added then heated to a temperature of 80^0C. When the temperature reaches 40^oC, the snakehead fish extract is added and stirred until homogeneous. The formulation is molded with a rubber / silicone mold, waited until it cools slightly, then put in a cold temperature (4^0C) for 20 minutes Then, stir until homogeneous and molded. Store in the refrigerator until solid. All gummies were prepared in the same procedures.

Table 1. Ingredients (grams) used in gummy formulation

Ingredients (g)	Formulation				
	P0	P1	P2	P3	P4
Fish Extract	0	28	56	84	112
Straweberry	140	112	84	56	28
Sugar	16	16	16	16	16
Honey	20	20	20	20	20
Gelatine	20	20	20	20	20
Karageenan	8	8	8	8	8

Proximate analysis based on AOAC[12] and sensory analysis are conducted with a hedonic test[13, 14].

3 Results and Discussion

Good quality albumin in snakehead fish extract can be seen from its chewy texture at room temperature. The chewier the texture at room temperature, the higher the albumin content and quality of the snakehead fish extract. Snakehead fish extract is divided into two types, identified by its color: yellow snakehead fish extract and white snakehead fish extract. Yellow snakehead fish extract has a chewy texture at room temperature, a strong, fishy aroma typical of snakehead fish, and blends well when mixed into a formula. Meanwhile, white snakehead fish extract has a hard texture at room temperature, a strong, rubbery aroma, and is difficult to blend into a formula. Therefore, this study used yellow snakehead fish extract to produce gummies.

Strawberries have different levels of ripeness. This can be seen in the outer color of the strawberries. Strawberries with a red-orange ripeness have a sour taste. When added to a formula, the resulting formula has a sour taste. Strawberries with a red ripeness have a slightly sour and sweet taste. When added to the formula, the resulting formula has a sweet taste. Therefore, this study used strawberries with a red ripeness to ensure the resulting formula matched the desired taste.

The result of proximate analysis were shown on Table 2. The proximate values did not show a consistent pattern due to the increasing of fish extract added to the parameters of protein, fat, carbohydrate, and water content. But, Ash content increased with increasing proportion of fish extract added. This indicates that the addition of fish extract can increase the total minerals in gummy candy.

Table 2. Nutrition value of gummy candies

Formulation	Protein (%)	Fat (%)	Carbohydrates (%)	Moisture Content (%)	Ash Content (%)
P 0	14.99	0.18	42.53	41.11	1.21
P 1	17.13	0.15	34.01	47.36	1.36
P 2	16.75	0.10	40.98	40.63	1.55
P 3	16.69	0.13	34.51	47.18	1.51
P 4	18.55	0.18	37.15	42.44	1.69

The recipe was further modified to find the right formula, the ninth recipe. This formula is divided into five recipes, differing in the concentration of snakehead fish extract and strawberry puree added. The ingredients used include strawberry puree, granulated sugar, honey, carrageenan, gelatin, water, and yellow snakehead fish extract. The preparation process begins by mixing the strawberry puree, granulated sugar, honey, and carrageenan until homogeneous. Heat with regular stirring until boiling, and gelatin dissolved in water is added until all components are well combined. The temperature is then lowered to room temperature and the snakehead fish extract is added. Stir until homogeneous, mold, and refrigerate until the formula solidifies. The formula is cut into small cubes or dice-shaped pieces and dried for approximately 24 hours at room temperature to prevent the formula from sticking or becoming moldy due to the wet conditions. The snakehead fish gummies are packaged and ready for consumption by the public, especially toddlers with malnutrition. The resulting formulation meets expectations: a dense, soft, and chewy texture. The fishy taste and aroma of the snakehead fish are masked by the strawberry, and the attractive reddish-brown color is achieved.

The physical properties of the snakehead fish gummies are evident in their texture and color. The results of the panelists' assessment of the product are presented in Figure 1. The best formula were P0, the gummies candy is reddish-brown in color, while the texture tends to be dense, soft, and chewy.

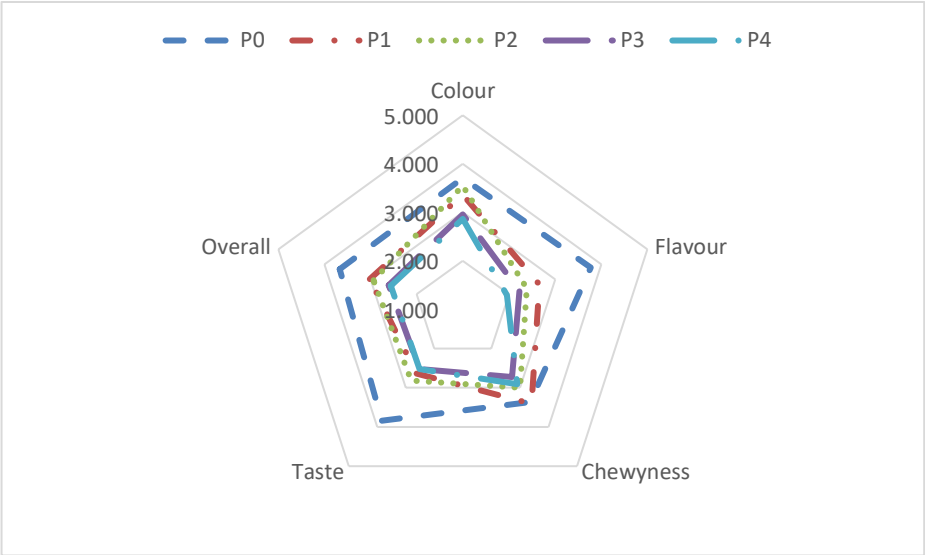

Fig. 1. Hedonic test in gummy candy

4 Conclusion

Increasing the proportion of fish extract increases the ash content in gummy candy. The acceptable characteristics of gummy candy made from a combination of gelatin and carrageenan are P0 with a chewy and dense texture, no aroma of snakehead fish juice, a red color, and a sweet taste with the distinctive fishy taste of snakehead fish juice that can be disguised.

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