

# PROXIMATE COMPOSITION AND SENSORY PREFERENCE OF BEEF SAUSAGE WITH DIFFERENT PERCENTAGE OF UNRIPE JACKFRUIT

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**ABSTRACT.** Underutilization of jackfruit and demand for healthier meat product with nutritional benefits and similar taste to meat had led to this study which to evaluate the proximate composition, and consumer preference of beef sausage with different percentage of unripe jackfruit. Five formulations of beef sausage were prepared with percentage of beef to unripe jackfruit were: Control (65:0), A (48.75:16.26), B (32.5:32.5), C (16.25:48.75), and D (0:65). Results found that carbohydrate contents of beef sausage with unripe jackfruit were higher ( $P>0.05$ ) than in control sausage but were lower ( $P>0.05$ ) in protein, fat, and fibre content. However, results found that all sausages with unripe jackfruit were found significantly higher ( $P<0.05$ ) in moisture content, and ash compared to control beef sausage. However, hedonic test found that consumers preferred ( $P<0.05$ ) control beef sausage compared to other formulations. Beef sausage incorporated with 25% unripe jackfruit was the most preferred by consumers in texture, taste, and overall acceptance among all sausage with unripe jackfruit. These findings obtained that formulation of beef sausage incorporated with unripe jackfruit could be accepted by consumers.

**Keywords:** beef sausage; nutritious sausage; jackfruit sausage; sausage preference

## Introduction

Sausage is defined as ground or chopped meat mixed with salt, seasonings, and other ingredients such as starch and oil which can be stuffed into a container or casing of particular shape and size. According to Abdolghafour and Saghir [1], sausages can be grouped into five types depending on preparation types which are fresh sausage, fermented sausage, smoked precooked sausage, emulsion-type sausage, and cooked sausage. Sausages contain high amount of protein but also high in fats which mostly in the form of saturated and unsaturated fats which contribute to calories [2]. In beef sausages, the protein and fat content ranged from 10.63 to 16.43%, and 1.1 and to 12.22%, respectively [3].

Meat analogue, also known as meat substitute, mock meat, faux meat or imitation meat is a meat replacer in a diet whereby it has a structure that is similar to meat but it is different in composition. In fact, soybean, mushrooms, legumes, wheat, rye and barley are the major non-meat protein sources suitable for meat analogue. These non-meat proteins are usually added with flavoring in order to produce products that taste like meat [4]. In meat product, meat analogues are created because of some believers are prohibited from eating meat like Buddhists and Hindus [5], awareness of health as animal-based diets are one of the contributors towards heart disease and cancers as they consist of high cholesterol and saturated fat [2], and vegetarian concern which belief that animal rights as it is wrong to kill animals and environmental factor as meat production would affect the environment [2, 5].

Usually the main component of plant-based protein that can be applied in beef sausage include glutes, globulins and soy proteins like tofu or tempeh [6]. Textured vegetable protein is widely used in sausage production as it gives meat fibrous structure similar to meat and flavour. Other than that, legumes, wheat gluten, mushroom, egg albumen, and carbohydrate gums could also be used in meat products to take benefits of their own functional properties [4]. Jackfruit or scientifically known as *Artocarpus heterophyllus* is a species of mulberry family is one of the abundance local fruits that can be easily found in Malaysia [7]. It was reported that flesh texture of unripe jackfruit is smooth and have similar texture to meat and tasteless. The flesh is able to absorb added flavorings like spice to imitate the meaty flavour [8]. Thus, the objectives of this study were to evaluate the proximate composition of beef sausage formulated with unripe jackfruit, and to evaluate the consumer preference of the sausages.

## Materials and Methods

### Preparation of Beef Sausage

There were five formulations of sausages was prepared with different percentage of beef to unripe jackfruit which are; control (100% ground beef without unripe jackfruit), B (75% ground beef and 25%), C (50% ground beef and 50%

jackfruit), D (25% ground beef and 75% jackfruit), and D (100% unripe jackfruit without ground beef). Initially, salt (1%) and cold water (9%) were blended in the food processor (MK-5087M, Panasonic, Malaysia) for ten seconds before mixing with ground beef with/ without unripe jackfruit for ten seconds. Then, other ingredients [soy protein isolate (6.4%), texturized vegetable protein (6%), vegetable oil (4.4%), potato starch (6%), seasonings (2%), and sodium tripolyphosphate (0.2%)] were added and blend together. All the ingredients were left to blend with a total of 110 seconds. Next, the batter was stuffed into cellulose casings using a hand operated stuffer and it was tied into 8 cm long sausage before cooking in an oven at 180°C for 15 minutes. Finally, the sausages were then immersed in cold water (6 °C) for 5 minutes before removing the casings and kept in frozen condition before analysis.

### **Determination of Proximate Composition**

Moisture analyser (MX-50, A&D Company Limited, Japan) was used to determine the moisture content of the cookies while ash content was carried out using dry ashing method with incineration in the muffle furnace (Carbollite, England) at 550°C. Protein were determined using Kjeldahl apparatus (BUCHI, Switzerland). Fat analysis was done using Automatic Soxhlet extraction method (Soxhterm® extractor, Gerhardt). Crude fibre was determined according to Gerhardt method using Fibretherm (Gerhardt GmbH, German). Finally, the carbohydrate content of all sausages was calculated by totaling up the percentage of moisture, ash, protein, and fat, followed by deducting the result from 100%. All analysis was done according AOAC [9] method.

### **Determination of Physical Properties**

Hardness and springiness of sausages were carried out using Texture Analyzer TA.XT Plus (Stable Micro System, Surrey, London) with 5 mm diameter spherical probe (P/5S). Colour of the cookies was analysed using colorimeter (LabScan®XE Spectrophotometer Model, HunterLab) based on  $L^*a^*b^*$  colour scale system.

### **Analysis of Sensory Preference**

Determination of preference of sausages was done using 7-point Hedonic test according to Meilgaard et al. [10] which the scale ranging from 1 (extremely dislike) to 7 (like extremely). The sensory evaluation was performed by 76 untrained panellists from Faculty of Science and Technology, Universiti Sains Islam Malaysia, Negeri Sembilan, Malaysia. All panellists were served with three-random digit coded number cookies samples to avoid bias. Each of the panellist was asked to evaluate the aroma, colour, texture, taste, and overall acceptance of sausages in an individual booth.

### **Statistical Analysis**

All data were analysed with one-way analysis of variance or ANOVA, followed by Tukey's test to compare the means between samples. Data was analysed using Minitab® software, Release 16 [11] and the statistical significance was established at ( $P<0.05$ ). All experiments were replicated in twice.

## **Results and Discussion**

### **Proximate Composition of Sausages**

The proximate composition of the sausages are shown in Table 1. Results found that the increment of unripe jackfruit in beef sausage formulations were significantly ( $P<0.05$ ) increased moisture, and ash contents of sausages but consistently decreased protein and fat contents of the sausages. However, incorporation of unripe jackfruit in beef sausage did not change ( $P>0.05$ ) fibre content of sausages.

**Table 1:** Proximate composition of beef sausages incorporated with unripe jackfruit compared to control beef sausage

Proximate Composition	Control	A	B	C	D
Moisture	57.81 <sup>a</sup>	59.28 <sup>c</sup>	62.20 <sup>bc</sup>	65.67 <sup>ab</sup>	68.72 <sup>a</sup>
Ash	2.41 <sup>b</sup>	2.39 <sup>b</sup>	2.64 <sup>ab</sup>	2.67 <sup>ab</sup>	2.78 <sup>a</sup>
Protein	20.54 <sup>a</sup>	16.74 <sup>ab</sup>	15.52 <sup>ab</sup>	12.78 <sup>ab</sup>	10.47 <sup>b</sup>
Fat	9.31 <sup>a</sup>	7.84 <sup>a</sup>	8.05 <sup>a</sup>	5.89 <sup>a</sup>	3.81 <sup>a</sup>
Carbohydrate	9.94 <sup>a</sup>	13.77 <sup>a</sup>	11.59 <sup>a</sup>	13.00 <sup>a</sup>	14.23 <sup>a</sup>
Fibre	4.54 <sup>a</sup>	3.94 <sup>a</sup>	3.32 <sup>a</sup>	4.41 <sup>a</sup>	4.44 <sup>a</sup>

Note: a) Different alphabetical letters within rows indicate significance different ( $P < 0.05$ ) among beef sausage samples. All data were replicated in twice.

b) Control= 100% ground beef; A= 25% unripe jackfruit and 75% ground beef; B= 50% unripe jackfruit and 50% ground beef; C= 75% unripe jackfruit and 25% ground beef; D= 100% unripe jackfruit

The moisture content of beef sausages incorporated with unripe jackfruit were higher than control beef sausage might be due to high moisture content of unripe jackfruit (Table 1) which ranged from 76.20 to 85.0% [12]. A previous study was also reported that meat patties with jackfruit contain higher moisture than without addition of jackfruit [8]. As expected, increment of unripe jackfruit in beef sausage consistently increased ash content (Table 1) and was in line with previous study [8]. However, protein content of control beef sausage was the highest ( $P < 0.05$ ) compared to formulation with unripe jackfruit and was also in agreement with previous study [8]. The protein in control beef sausage was necessarily from beef meat. The fat content of control beef sausage was the highest as expected and was due to the fat from beef content. The fat content of unripe jackfruit ranged from 0.01 to 0.06% [13].

Evaluation of carbohydrate content found that the lowest (9.94%) carbohydrate content was shown in control beef sausage as expected since beef meat considered did not contain carbohydrate and the content in the beef sausage was mainly contributed by potato starch. Carbohydrate content of unripe jackfruit was between 9.4 and 23.5% [12-13]. The fibre content of beef sausages ranged between 3.32 and 4.54%. Control beef sausage contained the highest fibre content while beef sausage incorporated with 50% jackfruit obtained the lowest fibre content. The decrement of fibre in beef sausage incorporated with unripe could be due to the heat treatment through boiling which can degrade fibre especially the soluble fibre in unripe jackfruit. Total dietary fibre in apple, corn, and oat bran degraded after autoclaving at 100°C for 30 minutes and 121°C for 15 minutes [14].

### Physical Properties of Sausages

The physical properties of sausages are shown in Table 2. Results found that the incorporated unripe jackfruit in beef sausage formulations increased ( $P > 0.05$ ) the hardness of beef sausage but decreased ( $P > 0.05$ ) the sausage springiness. In fact, the improvement of textural properties was associated to replacement of fat with different fibres [15].

**Table 2:** Physical properties of beef sausages incorporated with unripe jackfruit compared to control beef sausage

Physical Properties	Control	A	B	C	D
Hardness	4.84 <sup>a</sup>	5.27 <sup>a</sup>	6.06 <sup>a</sup>	5.81 <sup>a</sup>	5.87 <sup>a</sup>
Springiness	1.79 <sup>a</sup>	0.99 <sup>a</sup>	0.99 <sup>a</sup>	0.97 <sup>a</sup>	0.93 <sup>a</sup>
Lightness ( $L^*$ )	45.10 <sup>a</sup>	44.86 <sup>a</sup>	45.03 <sup>a</sup>	46.37 <sup>a</sup>	46.65 <sup>a</sup>
Redness ( $a^*$ )	3.31 <sup>b</sup>	3.20 <sup>b</sup>	3.09 <sup>b</sup>	3.65 <sup>b</sup>	5.00 <sup>b</sup>
Yellowness ( $b^*$ )	12.94 <sup>a</sup>	12.66 <sup>a</sup>	11.92 <sup>a</sup>	11.84 <sup>a</sup>	14.18 <sup>a</sup>

Note: a) Different alphabetical letters within rows indicate significance different ( $P < 0.05$ ) among beef sausage samples. All data were replicated in twice.

b) Control= 100% ground beef; A= 25% unripe jackfruit and 75% ground beef; B= 50% unripe jackfruit and 50% ground beef; C= 75% unripe jackfruit and 25% ground beef; D= 100% unripe jackfruit

Colour of sausages was also shown in Table 2. Incorporated unripe jackfruit in beef sausage affect the redness ( $P < 0.05$ ) of sausage but not in lightness and yellowish colour of sausages. The highest ( $P < 0.05$ ) redness colour of sausage was obtained in unripe jackfruit sausage (formulation D) and this might be due to the carotenoid pigment that provide red-yellowish colour in unripe jackfruit.

## Consumer Preference of Sausages

Table 3 shows consumer preference of beef sausage incorporated with different percentage of unripe jackfruit. As expected, results found that the control beef sausage obtained the highest ( $P<0.05$ ) mean scores for attributes colour, aroma, taste, and overall acceptance which are 5.88, 6.88, 6.76, and 6.90, respectively. However, in attribute texture the highest mean score was obtained in beef sausage A which was formulated with 75% beef and 25% unripe jackfruit.

**Table 3:** Consumer preference of beef sausages incorporated with unripe jackfruit compared to control beef sausage

Consumer Preference	Control	A	B	C	D
Colour	5.88 <sup>a</sup>	5.80 <sup>b</sup>	5.86 <sup>a</sup>	5.32 <sup>ab</sup>	5.03 <sup>b</sup>
Aroma	6.88 <sup>a</sup>	6.50 <sup>ab</sup>	6.61 <sup>ab</sup>	5.88 <sup>bc</sup>	5.37 <sup>c</sup>
Texture	6.46 <sup>a</sup>	6.55 <sup>a</sup>	6.45 <sup>a</sup>	4.61 <sup>b</sup>	3.58 <sup>c</sup>
Taste	6.76 <sup>a</sup>	6.67 <sup>a</sup>	6.49 <sup>a</sup>	5.03 <sup>b</sup>	3.84 <sup>c</sup>
Overall Acceptance	6.90 <sup>a</sup>	6.65 <sup>a</sup>	6.51 <sup>a</sup>	5.16 <sup>b</sup>	4.04 <sup>c</sup>

Note: a) Different alphabetical letters within rows indicate significance different ( $P<0.05$ ) among beef sausage samples. All data were replicated in twice.

b) Control= 100% ground beef; A= 25% unripe jackfruit and 75% ground beef; B= 50% unripe jackfruit and 50% ground beef; C= 75% unripe jackfruit and 25% ground beef; D= 100% unripe jackfruit

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