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Physicochemical and Sensory Properties of Bahulu and Chocolate Mousse Developed from Canned Pulse and Vegetable Liquids

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Abstract: Egg white is the most commonly used foaming agent in various aerated foods. Malaysia has been experiencing an egg crisis due to lower production and increased egg consumption rates since the COVID-19 restrictions were lifted. Thus, finding an alternative functional ingredient to address the egg shortage is essential. Liquids discarded from commercially plant-based canned foods have the potential to replace eggs in food products as an alternative foaming agent. Therefore, this study aims to investigate the physicochemical and sensory properties of bahulu and chocolate mousse using canned liquids of green peas (pulses N and P), lentils (pulse R), chickpeas (pulse X), button mushrooms (vegetable A), and straw mushrooms (Vegetable D). Canned liquids were incorporated into bahulu and mousse formulations to replace egg whites. The developed bahulu and mousse were baked for 25 min at 180 °C and chilled for 3 hours at 4 °C, respectively. The texture profile of bahulu and the viscosity properties of the chocolate mousse were determined in this study. Furthermore, the research examines the proximate analysis and sensory acceptance of both products. According to the findings, bahulu A, produced from canned vegetable liquids, had the lowest hardness, springiness, and chewiness ($p < 0.05$) levels. In contrast, canned pulse liquid, which was used in bahulu N, produced comparable hardness, fracturability, adhesiveness, springiness, cohesiveness, and chewiness with the control sample ($p > 0.05$). Moreover, the viscosity values of mousses A (2238.33 $\pm$ 2.89 cP) and D (2778.33 $\pm$ 2.89 cP) were lower than the control mousse (8005.00 $\pm$ 0.00 cP) ($p < 0.05$). Bahulu and mousse contain 6.58–6.83% and 1.52–1.90% of protein, respectively. The protein content of canned pulse liquid products was higher than that of canned vegetable liquids ($p < 0.05$). The lowest taste acceptance was observed in samples Bahulu N and P as well as mousses N and P ($p < 0.05$). This outcome could be due to the saltiness derived from the canned green pea liquid. The appearance, odor, and overall acceptability of the bahulu and mousse were comparable to the control samples and well-accepted by the panelists ($p > 0.05$). The findings demonstrate that canned pulse liquids (green peas, lentils, and chickpeas) can potentially mimic egg white in the development of bahulu and chocolate mousse.

Keywords: egg white; pulses; foaming agent; aerated foods; canned liquid

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1. Introduction

Aerated foods contain air or gas, which makes the finished products lighter and more voluminous [1]. Aerated foods can have both positive and negative consequences for the food industry. Extra cost and effort are required to create the desired aerated products with lower allergenicity levels of β-lactoglobulin that remains unaffected, even when heated [2]. Furthermore, the overbeating effect of liquid egg whites is permanent [3]. Advantageously, aerated foods add variety to food products, ranging from baked to chilled, resulting in a novel texture and sensory appeal [1]. The incorporation of air into food products produces foods with a softer texture. Mousses are the classic example of aerated food widely consumed, in which the incorporation and retention of bubbles are crucial in the success of the dish [4]. Mousse highly depends on its texture, which is supposed to be fluffy, soft, and airy. Good-quality mousse is when the foam is produced with an even distribution of smaller bubbles, resulting in a more stable and creamier mousse [5]. Bahulu is another example of an aerated food, which is very popular among Malaysians. Bahulu is prepared by baking in various shapes [6]. The most common shape of bahulu is bahulu cermai (button bahulu) and bahulu ikan emas (goldfish bahulu). Moreover, some of the aerated foods provide extra nutritional benefits to consumers. For instance, bread is high in fiber, which is good for human health. The foam inside food can enhance the food's texture, color, and novelty, thus increasing consumers' excitement towards a specific food product [7]. These include producing aerated foods, such as ice cream, cakes, soft drinks, and more.

Over the years, egg white has been extensively applied as an excellent foaming agent in many aerated foods, including mousse [8]. Egg white contains protein albumen that can rapidly absorb on the air–liquid interface during whipping and form a cohesive viscoelastic film through intermolecular interactions [9]. Some aerated foods' reliance on egg white may cause the demand for eggs to increase further. Situations, such as high feed costs, an unstable economy, and disease outbreaks disrupting egg production rates, will eventually have an impact on egg demand fulfilment. Recently, egg scarcity has emerged as one of Malaysia's most pressing issues, particularly following the relaxation of COVID-19 restrictions [10]. Thus, plant-based foods have gained significant attention from the community as an alternative foaming agent to replace egg whites [11]. Various plant proteins, such as pulses, are commercially available for the further development of plant-based products, including aerated foods [12]. A study was conducted on the proximate meringue composition and sensory evaluation of haricot beans, garbanzo chickpeas, whole green lentils, and split yellow pea liquids [13]. The meringue produced from these liquids had a lower moisture content than egg white meringue. However, the meringue from garbanzo chickpeas and whole green lentils produced comparable hardness compared to egg white meringue. Furthermore, the overall preference did not significantly vary from the liquids to egg whites. Another study showed that replacing egg whites with aquafaba did not considerably affect the physicochemical parameters of a sponge cake [14]. Thus, this research aims to investigate the physicochemical properties and sensory acceptance of bahulu and chocolate mousse developed from selected canned pulse and vegetable liquids. Aeration characterization is used to test the ability of various canned pulse and vegetable liquids to form foam. Based on the overrun results [15], liquids from green peas (pulses N and P), lentils (pulse R), chickpeas (pulse X), button mushrooms (vegetable A), and straw mushrooms (vegetable D) obtained overruns higher than 1000% and were chosen as potential foaming agents for bahulu and chocolate mousse development.

2. Materials and Methods

2.1. Materials

The commercial canned samples and eggs were obtained from Bataras Supermarket, Sabah. Other materials utilized were all-purpose flour, baking powder, cooking chocolate, butter, and sugar that were also obtained from Bataras Supermarket, Papar. Table 1 shows the types of canned pulse and vegetable liquid samples used and their symbols. Meanwhile, the nutritional information of the canned products as specified by the manufacturers is shown in Table 2.

Table 1. Canned pulse and vegetable liquid samples.

Materials	Manufacturers	Symbols
Button Mushroom	Myxo, China	Vegetable A, Bahulu A, Mousse A
Straw Mushroom	Rex, Malaysia	Vegetable D, Bahulu D, Mousse D
Green Pea	Sunstar, Malaysia	Pulses N, Bahulu N, Mousse N
Green Pea	Marina, Malalysia	Pulses P, Bahulu P, Mousse P
Lentils	Cirio, Italy	Pulses R, Bahulu R, Mousse R
Chickpea	Coppola, Italy	Pulses X, Bahulu X, Mousse X

Table 2. Nutritional composition of canned products.

Sample	Nutritional Composition					
	Protein (g)	Fat (g)	Carbohydrate (g)	Salt (mg)	Fiber (g)	Sugar (g)
Vegetable A (Button Mushroom)	1	0	4	330	2	2.2
Vegetable D (Straw Mushroom)	4	1	6.3			
Pulse N (Green Pea)	19	0	60	2400	25	
Pulse P (Green Pea)	5	1	10		4	
Pulse R (Lentils)	5.9		0.9	600	4.2	
Pulse X (Chickpea)	5.4	1.6	10.8	25	5.6	

2.2. Product Development

2.2.1. Bahulu

The process of making bahulu desserts was referred to and modified [6]. The formulation of bahulu developed from liquid egg whites as the control is shown in Table 3. Firstly, 100 g of all-purpose flour and 7 g of baking powder were prepared in a bowl (Mixture A). The flour was sifted for several minutes. Then, 110 g of liquid egg whites were beaten to form foam (Mixture B). Then, about 25 g of sugar was blended and whisked with mixture B for three minutes. Then, mixture A was added to and mixed with the sugar-foam ingredient by using a scraper, and placed in a bahulu mould. Lastly, the batter was baked under a preheated oven (Sinmag SM-994f, New Taipei City, Taiwan) at 180 °C for 25 min. The end-product was kept in an air-tight container at room temperature for a day prior to the texture profile analysis, proximate analysis, and sensory evaluation. The steps were repeated by replacing 100% of egg whites presented in the Table 3 formulation with pulses N, P, R, and X, and vegetables A and D liquids.

Table 3. Formulation of Bahulu control.

Material	Weight (g)
All-Purpose Flour	100
Baking Powder	7
Liquid Egg Whites	110
Sugar	25

2.2.2. Chocolate Mousse

For the chocolate mousse [16], the formulation of the mousse developed from liquid egg whites as the control is shown in Table 4. A total of 150 g of dark chocolate (Bakerchoize, Malaysia) was melted using the double-boiling method, and 50 g of butter was added to the melted chocolate. A total of 110 g of liquid egg whites was produced to form foam and

25 g of sugar was added to the foam. The chocolate and egg white foam were mixed and 5 g of lemon zest was then added. Lastly, the mixture was poured into a suitable container and stored in a chiller at 0–4 °C for three hours. The final product of the chocolate mousse was examined for viscosity, proximate analysis, and sensory evaluation. The stages were repeated by substituting the liquid from pulses N, P, R, and X, and vegetables A and D for 100% of the egg whites presented in Table 4's formulation.

Table 4. Formulation of mousse control.

Material	Weight (g)
Dark Chocolate	150
Butter	50
Liquid Egg Whites	110
Sugar	25
Lemon Zest	5

2.3. Texture Profile Analysis of Bahulu

TA.XT.Plus (Stable Micro Systems, Godalming, UK) with a 36 mm diameter cylinder was used to describe the bahulu's texture in terms of hardness, fracturability, adhesiveness, cohesiveness, springiness, gumminess, and chewiness [17]. The bahulu control and samples baked the day before were prepared by removing the bahulu's outer layer and crust and cutting it into a size of 25 mm × 25 mm × 25 mm. The test was performed by a measuring force on compression of 5 g, with the speed set at 2 mm/minute at a distance of 10 mm. Triplicate results were obtained for each sample [18].

2.4. Viscosity of Chocolate Mousse

The viscosity [19] values of the control and chocolate mousse samples were measured using a rotational viscometer (Brookfield DV-II+PRO, Middleboro, MA, USA). Speed and spindle were determined at the start of the experiment. The speed and spindle values were determined by observing the percentage values of the results. The percentage must be between 10–100%. Spindle 4, with a speed of 0.5 rpm, was the best option to determine the egg and samples' viscosity values. The time taken to measure the viscosity was two minutes. Triplicate results were obtained for all samples.

2.5. Proximate Analysis

The proximate composition of bahulu and chocolate mousse desserts was determined according to the methods described by the Association of Official Analytical Chemists [20]. Protein content was measured using the Kjeldahl method, N × 6.25 (FOSS Kjeltec^{TM} 2300, Hillerød, Denmark), fat content (FOSS Soxtec^{TM} 8000, Hillerød, Denmark), ash content by a muffle furnace (Thermo Scientific, Waltham, MA, USA) at 550 °C, and moisture content by the oven-drying method in an incubator oven (Fisher Scientific, Waltham, MA, USA) at 105 °C. The crude fiber content was determined through the gravimetric method by using a fiber bag, Fibretherm (Gerhardt, Germany), dried in an oven at 105 °C overnight, and incinerated at 550 °C overnight. Carbohydrate content was calculated as 100% (protein content %—fat content %—moisture content %—ash content %—fiber content %). The results are expressed in percentages (%). Lastly, the caloric value (Cal) of bahulu was estimated: Calorie (kcal) = (Crude Protein × 4 kcal) + (Crude Fat × 9 kcal) + (Crude Carbohydrate × 4 kcal) [21].

2.6. Sensory Evaluation

A sensory evaluation was conducted to determine the preference and acceptance of the dessert, according to the methods of Lawless and Heymann [22]. A laboratory sensory test to determine the degree of liking and disliking both bahulu and chocolate mousse was conducted using a 9-point rating scale (extremely dislike to extremely like). About 10 g of bahulu and chocolate mousse samples were weighed and labeled randomly with a

3-digit-code sample prior to food tasting. Water was provided for each panelist to cleanse their mouths. About 40 untrained panelists from the Faculty of Food Science and Nutrition, Universiti Malaysia Sabah, were selected to evaluate the appearance, color, odor, taste, texture, and overall acceptability of the bahulu and chocolate mousse desserts.

2.7. Statistical Analysis

The data were represented as mean ± standard deviation. The means of collected data were analyzed by advanced analysis in the Statistical Package (SPSS Inc., version 26.0) application for Windows and ANOVA tests. The differences between the mean values were calculated using Duncan's multiple comparison tests at a 95% confidence level ($p < 0.05$). The bivariate Pearson's correlation was used for the linear relationship between the determination of two variables.

3. Results and Discussions

3.1. Physicochemical and Sensory Properties of Bahulu

3.1.1. Texture Profile Analysis of Bahulu

Table 5 shows the texture profile analysis result of bahulu composed of canned liquid samples and egg whites. Bahulu developed from vegetable D and pulses N, P, and X had a hardness profile comparable to the Bahulu control ($p > 0.05$), while bahulu developed from vegetable A and pulse R had lower and higher levels of hardness, respectively, compared to the Bahulu control ($p < 0.05$). Hardness can be defined as the first mastication of food redesigned by a uniaxial compression test, where stress is required to deform a food in an approximately linear way to be reproduced [23]. A similar pattern can be observed in the hardness result for meringue, where the meringue created from garbanzo chickpeas had a comparable hardness profile to those produced from egg whites [13]. Vegetable A had the lowest foam stability with a drainage ratio of 1.14, resulting in a weak and less elastic foam. Because of these factors, foam created from canned vegetable liquids had a decreased ability to retain an aerated structure than the other samples, resulting in a softer texture for Bahulu A [23]. Similarly, sponge cake developed from aquafaba [14] had a lower hardness result than an egg white sponge cake. This result could be attributed to the differences in the foam stability of aquafaba and egg whites. It has been reported that the interaction of protein and insoluble carbohydrates during the canning process affects the viscosity of aquafaba [24]. The liquid for pulse R had a higher viscosity of 41.1 cP when compared to the liquids for pulses N and P, as well as vegetables A and D. Because the higher viscosity improved the foaming stability, Bahulu R was slightly harder than the other samples. Foam stability is determined by the thickness and strength of the interface film, which is related to the high viscosity of the continuous phase [25]. The protein contents of vegetable A and pulse N, as specified by the manufacturer, were lower and higher, respectively, when compared to the other types of commercial vegetable and pulse cans (Table 2). Furthermore, when compared to other canned liquid samples, pulse N had the highest protein (2.18%), salt (7.70%), and sugar (8.90%) contents, according to our study (unpublished data). As the protein concentration increases, so does the foaming stability [26]. Similarly, higher salt and sugar contents increase the liquid's viscosity, resulting in a more stable foam for pulse N [26].

The fracturability of Bahulu samples A, D, N, P, R, and X were comparable to the Bahulu control ($p > 0.05$). Fracturability is the tendency for the bahulu to break during the instrumental test [27]. Bahulu produced from potential canned liquid samples breaks at the same rate as bahulu created from egg whites when it is eaten. Therefore, all the canned liquid samples possessed similar brittleness levels as egg whites, which is necessary for consumers' eating experience. High fracturability and hardness levels with low cohesiveness are important texture characteristics for crispy, baked, or dry aerated foods [28].

Table 5. Texture profile analysis of Bahulu.

Sample	Hardness (g)	Fracturability	Adhesiveness (mJ)	Springiness (mm)	Cohesiveness	Chewiness (mJ)
Control	4.03 ± 0.01 [b]	4.11 ± 0.04 [a,b,c]	−0.08 ± 0.03 [e]	0.99 ± 0.01 [e]	0.87 ± 0.02 [c]	3.49 ± 0.09 [f]
Bahulu A	3.91 ± 0.01 [a]	4.03 ± 0.01 [a]	−1.89 ± 0.02 [c]	0.38 ± 0.04 [a]	0.57 ± 0.02 [a,b]	0.89 ± 0.02 [a]
Bahulu D	4.11 ± 0.02 [b,c]	4.22 ± 0.07 [b,c]	−2.52 ± 0.02 [a]	0.61 ± 0.05 [b]	0.51 ± 0.01 [a]	1.34 ± 0.02 [c]
Bahulu N	4.03 ± 0.01 [b]	4.13 ± 0.01 [a,b,c]	−0.04 ± 0.02 [e]	0.99 ± 0.01 [e]	0.86 ± 0.01 [c]	3.49 ± 0.09 [f]
Bahulu P	4.08 ± 0.12 [b,c]	4.13 ± 0.13 [a,b,c]	−2.19 ± 0.08 [b]	0.58 ± 0.08 [b]	0.51 ± 0.05 [a]	1.19 ± 0.04 [b]
Bahulu R	4.15 ± 0.03 [c]	4.23 ± 0.01 [c]	−0.01 ± 0.01 [e]	0.83 ± 0.02 [d]	0.60 ± 0.05 [b]	2.18 ± 0.06 [e]
Bahulu X	4.10 ± 0.09 [b,c]	4.09 ± 0.08 [a,b]	−1.56 ± 0.06 [d]	0.73 ± 0.05 [c]	0.55 ± 0.07 [a,b]	1.92 ± 0.16 [d]

Different letters in the same column indicate significant differences ($p < 0.05$); mean ± S.D., $n = 3$.

As for the adhesiveness, there were no significant differences in the bahulu developed from pulses N and R to the Bahulu control ($p > 0.05$). Meanwhile, the bahulu developed from pulse P and vegetables A and D had a higher level of adhesiveness compared to the control sample ($p < 0.05$). Adhesiveness represents the ability of the cake to adhere to the teeth when chewed. Therefore, a higher negative value of adhesiveness results in greater adhesive [29]. A low level of adhesiveness is preferable as bahulu is a solid food and should be easier to chew and swallow without it adhering too much to the teeth. Bahulu samples N and R had a better texture in terms of adhesiveness compared to other bahulu developed from canned liquids. The high level of adhesiveness in other bahulu samples might be attributed to the higher moisture content, as displayed in Table 6. Sucrose, which was added to the bahulu formulation, has a high water affinity due to its hygroscopic properties [30]. As a result, sugar prevents baked goods from drying out and becomes more adhesive.

Table 6. Proximate composition of bahulu.

Sample	Protein (%)	Fat (%)	Ash (%)	Fiber (%)	Moisture (%)	Carbohydrate (%)	Caloric Value (kcal)
Bahulu Control	10.43 ± 0.31 [c]	0.49 ± 0.01 [b]	4.21 ± 0.02 [a]	0.22 ± 0.01 [a]	35.40 ± 0.01 [c]	49.26 ± 0.31 [a]	243.13 ± 0.20 [c]
Bahulu A	0.35 ± 0.04 [a]	1.24 ± 0.03 [d]	4.42 ± 0.01 [b]	0.20 ± 0.02 [a]	36.45 ± 0.02 [d]	57.34 ± 0.05 [d]	241.88 ± 0.20 [b]
Bahulu D	0.44 ± 0.01 [a]	1.26 ± 0.01 [d]	4.43 ± 0.02 [b]	0.20 ± 0.01 [a]	36.43 ± 0.01 [d]	57.23 ± 0.02 [d]	242.01 ± 0.09 [b]
Bahulu N	6.83 ± 0.26 [b]	0.09 ± 0.01 [a]	4.49 ± 0.05 [c]	0.22 ± 0.01 [a]	35.42 ± 0.02 [c]	52.95 ± 0.29 [b]	239.95 ± 0.14 [a]
Bahulu P	0.67 ± 0.49 [a]	1.29 ± 0.09 [d]	4.52 ± 0.02 [c]	0.22 ± 0.01 [a]	36.43 ± 0.01 [d]	56.90 ± 0.57 [d]	241.87 ± 0.37 [b]
Bahulu R	6.58 ± 0.54 [b]	0.06 ± 0.02 [a]	4.45 ± 0.01 [bc]	0.22 ± 0.01 [a]	34.05 ± 0.01 [b]	54.64 ± 0.50 [c]	245.44 ± 0.03 [d]
Bahulu X	6.70 ± 0.36 [b]	0.71 ± 0.01 [c]	4.20 ± 0.03 [a]	0.21 ± 0.01 [a]	33.58 ± 0.01 [a]	55.59 ± 0.37 [c]	251.57 ± 0.15 [e]

Different letters in the same column indicate significant differences ($p < 0.05$); mean ± S.D., $n = 3$.

Springiness is the rate at which the bahulu recovers from a deforming force [31]. Bahulu N recovered more rapidly and did not break as easily as the other bahulu developed from canned liquid samples, similar to the control sample. When foam is stable, it assists in holding the structure of a food product. Foam with sugar is stable and appears less stiff [32], thus enhancing food attributes and increasing product acceptance. On the other hand, cohesiveness measures the strength of internal bonds composing the bahulu product [33]. The deformation rate depends on the strength of the bahulu and the difficulty level of breaking the inner bonds [34]. Therefore, a certain level of cohesiveness in bahulu is preferable, especially its internal bonds, similar to egg white bahulu. The internal bond strength of Bahulu N was comparable to the egg white bahulu, which resulted from the foaming stability of pulse N. Only bahulu produced from pulse N had similar springiness, cohesiveness, and chewiness characteristics as the Bahulu control ($p > 0.05$). Meanwhile, bahulu developed from vegetables A and D, and pulses P, R, and X had reduced springiness, cohesiveness, and chewiness values compared to the control sample ($p < 0.05$).

Bahulu composed of pulse P and vegetables A and D had a reduced chewiness value compared to the bahulu composed of pulses R and X ($p < 0.05$). Chewiness can be described as the energy needed to chew solid food [35], in this case bahulu, until it is ready to be swallowed. It is the relation between hardness X cohesiveness X springiness. In all three parameters, Bahulu N had the most similarities to the Bahulu control. Pulse N had the highest protein and salt contents (Table 2), which contributed to the formation of a stable foam from its liquid, resulting in a more chewable product. The chewiness level of bahulu produced from pulse P (1.19 ± 0.04 mJ) and vegetables A (0.89 ± 0.02 mJ) and D (1.34 ± 0.02 mJ) was too low, which may reduce consumers' enjoyment of chewing the bahulu before swallowing it. In a previous study [36], chickpea flour decreased gluten-free muffins' springiness, cohesiveness, and chewiness levels. Similarly, bahulu made from chickpeas and other pulse and vegetable liquids in this study had lower springiness, cohesiveness, and chewiness. Pulse N was an exception, where its bahulu had similar springiness, cohesiveness, and chewiness levels compared to the Bahulu control ($p > 0.05$). The chewiness parameter showed a positive correlation in the bivariate Pearson's correlation ($R^2 = 0.859$) to the hardness parameters of bahulu. A similar positive-correlation trend of chewiness and hardness was also observed in eggless cake containing soy milk [37].

3.1.2. Proximate Composition of Bahulu

The Bahulu control contained the highest protein content of 10.43% (Table 6) among the bahulu developed from canned liquid samples ($p < 0.05$). The protein content of bahulu produced from canned pulse liquids ranged from 6.58 to 6.83%, which was higher than that of canned vegetable liquids, but lower than that of the Bahulu control. This suggested that using canned liquids may reduce the protein content of bahulu when compared to egg whites. A previous study [11] showed that aquafaba contained heat-stable proteins, which might delay protein denaturation and coagulation during baking, contrary to liquid egg whites that are heat-sensitive. Therefore, canned pulse liquid foams were able to hold their protein content after the baking process.

All bahulu samples had different amounts of fat than the control sample ($p < 0.05$). The fat contents of the Bahulu control (0.49%), N (0.09%), R (0.06%), and X (0.71%) were lower than the bahulu developed from pulse P (1.29%) and vegetables A (1.24%) and D (1.26%). Nevertheless, all the samples contained a low fat content. This outcome might be because the canned pulse and vegetable liquids contained less than 1% of fat. Moreover, the nutritional information specified by the manufacturers also indicated the fat content of the product was about 1 g (Table 2). In another study [6], rice bran had a high fat content (16–22%), contributing to the fat content in bahulu. The fat content of the bahulu developed from canned liquid samples was much lower, between 0%–1.3%. Thus, canned liquid samples are proven to be a good choice for an alternative foaming agent, as bahulu with a reduced fat content was able to be produced.

Ash levels in bahulu developed from vegetables A and D, as well as pulses N, P, and R, were higher in the range of 4.42–4.45% than in Bahulu X (4.20%) and the Bahulu control (4.21%) ($p < 0.05$). Meanwhile, the amount of crude fiber in all bahulu samples was comparable to the egg white bahulu ($p > 0.05$). All bahulu composed of canned pulse and vegetable liquids contained a significant amount of ash and fiber as the control variables, which made the canned liquid samples beneficial for food-product development. Most of the ash content resulted from the other products used to make bahulu, such as flour and sugar. A higher ash content in the bahulu produced from canned liquids was probably attributed to the flour used. Wheat flour contains ash that becomes a major indicator of wheat flour's quality and use [38]. Therefore, it was suggested that the usage of flour in making bahulu desserts in this study contributed to the ash and fiber contents. The presence of fiber in bahulu improved its texture. This was demonstrated in a study in which fiber increased the elasticity of cake or muffin batter, resulting in a firmer and less cohesive cake or muffin [39].

There were no significant differences in the moisture content between Bahulu N and the Bahulu control ($p > 0.05$), both of which had a moisture content of around 35.4%. However, with the addition of vegetables A and D, and pulse P, the moisture content of the bahulu products slightly increased to 36.4%. ($p < 0.05$). In contrast, for pulses R and X, the moisture content slightly decreased, ranging from 33.5 to 34.0% ($p < 0.05$). Moisture in a food product is crucial as food needs to have a certain level of moisture to maintain its texture, shape, and taste, and remain safe from microbial growth. Extra water in a food product can increase the rate of microbial growth [40]. All the samples had a moisture content of around 30%, the same as the egg white bahulu's moisture level. Similarly, a cake made with aquafaba has a moisture content of 21.44%, which is around 20%, comparable to a cake made with egg whites (22.18%) [14]. Therefore, the bahulu composed of canned liquid samples had a moisture content suitable for maintaining its texture and shape as the Bahulu control.

The amount of protein in the bahulu developed from canned liquids was much lower than in the Bahulu control. Therefore, the carbohydrate percentage was higher in the bahulu produced from canned liquid samples. The carbohydrate content of the egg white bahulu was the lowest compared to the bahulu developed from vegetables A and D and pulses N, P, R, and X ($p < 0.05$). Carbohydrates are important as the main source of energy [41]. Similar to the Bahulu control, bahulu produced from pulses N, P, R, and X and vegetables A and D can be consumed as a source of energy. Moreover, a higher carbohydrate content might improve the foaming properties of bahulu composed of canned liquid samples. For instance, the foaming capacity is significantly increased when sucrose (carbohydrate) is present in whey protein isolates [42]. Finally, the caloric value of the Bahulu control (243.13 kcal) was higher than that of Bahulu samples A (241.88 kcal), D (242.01 kcal), N (239.95 kcal), and P (241.87 kcal), but lower than that of Bahulu samples R (245.44 kcal) and X (245.44 kcal) (251.57 kcal) ($p < 0.05$). The calories in fat, protein, and carbohydrates vary depending on the food [43]. In the bahulu products, egg white bahulu had the highest amount of protein, which contributed to the higher number of calories than Bahulu samples A, D, N, and P.

3.1.3. Sensory Properties of Bahulu

Table 7 shows the results of the sensory test for bahulu made from selected canned liquids and control egg whites. There was no significant difference between the Bahulu control and Bahulu samples A, D, N, P, R, and X ($p > 0.05$) in appearance. The original appearance of bahulu is commonly bahulu cermai (star-shaped button) [44]. All the bahulu samples looked identical to the Bahulu control (Figure 1a). Figure 1b,c represent a picture of bahulu developed from canned pulse (Bahulu X) and vegetable (Bahulu A) liquids.

Table 7. Sensory properties of Bahulu samples.

Sample	Appearance	Color	Odor	Taste	Texture	Overall Acceptability
Bahulu Control	6.30 ± 1.86^{a}	6.30 ± 2.00^{b}	6.43 ± 1.53^{a}	6.60 ± 1.53^{b}	6.20 ± 1.64^{a}	7.35 ± 1.19^{a}
Bahulu A	6.15 ± 1.70^{a}	6.23 ± 2.07^{b}	6.53 ± 1.57^{a}	6.60 ± 1.53^{b}	6.03 ± 1.54^{a}	7.03 ± 1.46^{a}
Bahulu D	6.20 ± 1.80^{a}	6.13 ± 2.03^{b}	6.50 ± 1.59^{a}	6.60 ± 1.53^{b}	6.05 ± 1.54^{a}	7.35 ± 1.19^{a}
Bahulu N	6.25 ± 2.00^{a}	4.40 ± 2.05^{a}	6.53 ± 1.62^{a}	4.73 ± 2.69^{a}	6.18 ± 1.57^{a}	7.40 ± 0.93^{a}
Bahulu P	6.25 ± 2.00^{a}	4.30 ± 2.07^{a}	6.50 ± 1.59^{a}	4.73 ± 2.69^{a}	6.20 ± 1.56^{a}	7.23 ± 1.19^{a}
Bahulu R	6.35 ± 1.90^{a}	4.38 ± 2.08^{a}	6.43 ± 1.53^{a}	6.60 ± 1.53^{b}	6.13 ± 1.59^{a}	7.10 ± 1.53^{a}
Bahulu X	6.30 ± 1.86^{a}	6.30 ± 2.00^{b}	6.43 ± 1.53^{a}	6.60 ± 1.53^{b}	6.10 ± 1.61^{a}	7.18 ± 1.24^{a}

Different letters in the same column indicate significant differences ($p < 0.05$).

The colors of Bahulu A, D, and X were similar to the Bahulu control ($p > 0.05$). Meanwhile, the bahulu produced from pulses N, P, and R had a significantly different color compared to the Bahulu control ($p < 0.05$). The color of the original Bahulu control was brown. The color was the result of the flour, sugar, and baking powder being mixed and baked at 180 °C. The browning effect was caused by the Maillard reaction, which was triggered by the presence of amino acids in the flour protein, sugar, and a high temperature [45]. In addition to the Maillard reaction, caramelization occurred when the carbohydrate content of the bahulu was exposed to high temperatures [45]. Liquid egg whites, vegetables A and D, and pulse X produced a white-colored foam, and thus did not affect the bahulu's color. The liquid color of Bahulu samples N and P was green, producing light-green foam. As for Bahulu R, the canned liquid was produced from pulse R with a red color; hence, the foam was light red. The color of the foam affected the color of the end product, with Bahulu samples N and P being a slightly greenish, while Bahulu R appeared red. Similarly, a study showed that the appearance of whole-green-lentil meringues was rated lower than others due to the color of the whole green lentils [13]. Nevertheless, the color change was not significant to the panelists' preferences of bahulu as the shape was still the same as the Bahulu control.

(**a**) (**b**) (**c**)

Figure 1. (**a**) Bahulu control; (**b**) Bahulu X; (**c**) Bahulu A.

The aroma or odor is sensed by olfactory receptors in the nasal epithelium [46]. This aroma or volatile molecule is usually inhaled into the nose or during chewing through the back of the throat. A particular volatile molecule then produces a specific smell. All of the bahulu products developed from canned liquid samples had the same odor or aroma as the Bahulu control ($p > 0.05$). Using canned liquid samples to produce bahulu desserts did not affect the original aroma or odor. Bahulu samples N and P were significantly different from the control sample ($p < 0.05$), while Bahulu samples A, D, R, and X were not significantly different ($p > 0.05$) in terms of taste. Taste is the most decisive criterion to be considered when making a dessert [47]; thus, it has a major impact on the final decision. Bahulu samples N and P were composed of the selected green pea liquids that could be influenced by the salt content, as specified by the manufacturer, particularly in pulse P, which contained of 2400 mg of salt (Table 2). Both bahulu tastes were slightly salty, resulting in a poor taste value. The presence of more salt decreased the moisture content [48] in Bahulu samples N and P, making the products taste saltier. Originally, bahulu has a sweet taste [44] similar to the Bahulu control and other bahulu samples in this study.

Furthermore, all the bahulu samples were not significantly different from the control sample ($p > 0.05$) in terms of texture. Foam stability is crucial for the good texture of a food product [49]. As bahulu is classified as an aerated food, the structure of the food, or texture, strongly depends on its foamability and foam stability. The bahulu samples developed from canned liquid samples were successfully created with a similar texture as the Bahulu control. Overall, the panelists provided positive feedback for all the bahulu desserts ($p > 0.05$). A similar result was obtained for the study of meringues [13]. The overall preference did not significantly vary across the meringues produced from pulse liquids. Therefore, the pulse and vegetable liquids used in this study could produce successful solid–aerated foods, although the liquid samples had different stability rates.

3.2. Physicochemical and Sensory Properties of Chocolate Mousse

3.2.1. Viscosity of Chocolate Mousse

The viscosity properties of mousses N, P, and X were not significantly different to egg whites ($p > 0.05$) (Table 8). Meanwhile, the viscosity value of chocolate mousse developed from vegetables A and D was lower than egg whites ($p < 0.05$). Food texture depends on viscosity, especially for liquid or semi-liquid foods [50]. The lower viscosity levels of mousses A and D (2238.33cP and 2778.33cP) might have been due to the lower viscosity of the canned liquids from vegetables A and D (20.67cP and 23.17cP). Differences in viscosity cause differences in texture [51]. Vegetable-based chocolate mousses were more watery than pulse-based chocolate mousses, which were more solid. This outcome was due to the differences in the viscosity levels of the mousses developed from canned vegetable and pulse liquids. Mousses N, P, R, and X had viscosity levels ranging from 8001 to 8005cP, which were much higher than mousses A and D. Thus, mousses A and D were less accepted in the viscosity analysis.

Table 8. Viscosity of chocolate mousses.

Sample	Viscosity (cP)
Mousse Control	8005.00 ± 0.00^{d}
Mousse A	2238.33 ± 2.89^{a}
Mousse D	2778.33 ± 2.89^{b}
Mousse N	8004.33 ± 0.58^{cd}
Mousse P	8002.33 ± 1.53^{cd}
Mousse R	8001.67 ± 0.58^{c}
Mousse X	8004.33 ± 0.58^{cd}

Different letters in the same column indicate significant differences ($p < 0.05$); mean ± S.D., $n = 3$.

3.2.2. Proximate Composition of Chocolate Mousse

The mousse control had the highest protein content of 4.69%, which was higher than the mousses produced from canned liquid samples ($p < 0.05$) (Table 9). Chocolate mousse produced from canned pulse liquids contained more protein, ranging from 1.52–1.90%, than the canned vegetable liquids (0.68–0.80%). This was also due to the heat-stable protein in the pulse liquids. Meanwhile, the protein content of the egg white mousse was lower than the egg white bahulu (Table 6). The double-boiling method used in making egg white mousse to melt the chocolate and butter, then folded with egg white and canned liquid foams, caused the protein inside the egg white foam to denature as there was a change in the temperature. Egg white protein is sensitive to high temperatures as it can easily denature and coagulate [52].

Table 9. Proximate compositions of chocolate mousses.

Sample	Protein (%)	Fat (%)	Ash (%)	Fiber (%)	Moisture (%)	Carbohydrate (%)	Caloric Value (kcal)
Mousse Control	4.69 ± 1.18^{c}	28.62 ± 0.01^{b}	1.01 ± 0.01^{c}	2.07 ± 0.12^{a}	28.95 ± 0.01^{b}	34.65 ± 1.15^{c}	423.26 ± 0.01^{b}
Mousse A	0.80 ± 0.10^{a}	49.04 ± 0.01^{d}	0.88 ± 0.01^{b}	2.06 ± 0.05^{a}	27.70 ± 0.01^{a}	19.53 ± 0.12^{b}	531.60 ± 1.28^{d}
Mousse D	0.68 ± 0.50^{a}	49.02 ± 0.02^{d}	0.88 ± 0.02^{b}	2.06 ± 0.04^{a}	27.72 ± 0.01^{a}	19.64 ± 0.52^{b}	531.96 ± 2.18^{d}
Mousse N	1.90 ± 0.18^{b}	25.31 ± 0.08^{a}	0.80 ± 0.01^{a}	2.10 ± 0.02^{a}	30.01 ± 0.01^{c}	39.89 ± 0.25^{d}	403.88 ± 0.59^{a}
Mousse P	0.92 ± 0.06^{ab}	49.07 ± 0.01^{d}	0.79 ± 0.01^{a}	2.02 ± 0.04^{a}	27.71 ± 0.05^{a}	19.50 ± 0.13^{b}	530.55 ± 1.42^{d}
Mousse R	1.52 ± 0.43^{ab}	48.03 ± 0.01^{c}	1.01 ± 0.01^{c}	2.08 ± 0.08^{a}	30.00 ± 0.01^{c}	17.36 ± 0.44^{a}	514.44 ± 2.90^{c}
Mousse X	1.82 ± 0.17^{b}	25.35 ± 0.01^{a}	1.00 ± 0.01^{c}	2.07 ± 0.06^{a}	29.98 ± 0.02^{c}	39.78 ± 0.13^{d}	403.36 ± 0.81^{a}

Different letters in the same column indicate significant differences ($p < 0.05$); mean ± S.D., $n = 3$.

The fat contents of mousses N (25.31%) and X (25.35%) were less than the mousse control (28.62%) ($p < 0.05$), whereas the fat contents of mousses A (49.04%), D (49.02%), P (49.07%), and R (48.03%) were higher than the control sample ($p < 0.05$). The stability of oil foam in chocolate aeration greatly depends on drainage [53]. Increasing the level of egg yolk would decrease the foam stability of the egg white [54]. This outcome suggests that foam stability is crucial, especially in food products, such as chocolate mousse, and fat content decreases foam's stability. Additionally, other studies reported that high-fat milk may decrease the foaming ability, stability, and functionality of aerated dairy products [55]. A stable foam maintains its initial properties, forming a viscoelastic film to surround air bubbles, thus making it difficult to collapse [56]. Therefore, a higher foam stability in egg whites (drainage ratio: 0.00), pulse N (drainage ratio: 0.02), and pulse X (drainage ratio: 0.00) produced a stable mousse texture in the control mousse and mousses N and X so that the oil or fat was not separated from the product. A higher drainage ratio for pulse P (0.06), pulse R (0.14), vegetable A (1.14), and vegetable D (1.14) caused the lower stability of mousses P, R, A, and D, which altered the mousses' properties, and high-fat mousses were produced.

Mousses A (0.88%), D (0.88%), N (0.80%), and P (0.79%) contained a significant amount of ash, albeit slightly less than the mousse control (1.01%) ($p < 0.05$). As for the fiber, all mousses had a comparable amount of fiber content to the mousse control ($p > 0.05$). The ash and fiber contents in all the mousse samples might be attributed to the chocolate and sugar used. This outcome shows that pulses N, P, R, and X, and vegetables A and D were beneficial when used as foaming agents in making chocolate mousses, similar to liquid egg whites. Furthermore, the hydrophilic surface of fiber can combine well with bubbles at the interface, strengthening the liquid sample's film and increasing the surface viscosity, thereby increasing the foaming stability [57]. Fiber and viscosity in this study showed a positive correlation in the bivariate Pearson's correlation, $R^2 = 0.732$, where a higher fiber content leads to greater viscosity. From Table 9, it can be observed that mousses A, D, and P have moisture contents ranging from 27.70–27.72% that are lower than the mousse control (28.95%), whereas mousses N, R, and X have moisture contents ranging from 29.98–30.01% that are higher than the mousse control (28.95%) ($p < 0.05$). The food moisture appears in two forms: first, water bound to ingredients in the food, such as protein, salt, and sugar; second, free or unbound water that is available for microbial growth [48]. Mousses N, R, and X had a similar texture as the mousse control, where the texture was soft and smooth. Meanwhile, for mousses A, D, and P, due to their lower viscosity values (Table 8) stability, the texture was seen to be slightly watery as the water was not fully incorporated into the mousses. These available, unbound waters were susceptible to microbial growth [40].

In bahulu, the carbohydrate content was lower when the protein content was higher. Contrarily, mousses A, D, P, and R had a low carbohydrate content, although the protein was low as fat was higher in these mousses. Mousses A, D, P, and R had carbohydrate contents ranging from 17.36 to 19.64% lower than the mousse control of 34.65%, while mousses N (39.89%) and X (39.78%) had carbohydrate contents higher than the mousse control ($p < 0.05$). Mousses N and X had a higher carbohydrate content as the protein and fat contents were low. The mousse control (423.26 kcal) had a higher caloric value than mousses N (403.88 kcal) and X (403.88 kcal). Mousses A (531.60 kcal), D (531.96 kcal), P (530.55 kcal), and R (514.44 kcal) had higher caloric values than the mousse control ($p < 0.05$), which could be attributed to their fat content. Fat has more calories per gram than protein and carbohydrates combined [58].

3.2.3. Sensory Properties of Chocolate Mousse

For the chocolate mousse, all of the mousse samples' appearance were not significantly different to the mousse control ($p > 0.05$) (Table 10). All the mousses looked the same as they did not have a fixed shape. The shape of the chocolate mousse was formed by the container used. All mousse samples' colors were similar to the mousse control ($p > 0.05$). Usually, chocolate mousse appears to be brown to darker brown in color, imitating the color of the chocolate. The dominant brown color of the chocolate was not affected by the color of the canned liquid samples. Mousse A was a slightly darker shade of brown because of the mousse's lower viscosity level and higher moisture content, as presented in Tables 8 and 9, respectively. Most panelists could not differentiate between the smell of the desserts; thus, there was no significant difference ($p > 0.05$) between the samples and control samples. All the mousse samples had a sweet smell similar to the mousse control. Originally, chocolate mousses should have a sweet to bittersweet taste depending on the amount of cocoa in the chocolate.

Table 10. Sensory properties of chocolate mousses.

Sample	Appearance	Color	Odor	Taste	Texture	Overal Acceptability
Mousse Control	6.30 ± 1.57 [a]	6.85 ± 1.69 [a]	6.08 ± 1.61 [a]	7.18 ± 1.41 [b]	6.18 ± 1.68 [c]	7.40 ± 0.87 [ab]
Mousse A	6.00 ± 2.10 [a]	6.90 ± 1.66 [a]	5.98 ± 1.66 [a]	7.18 ± 1.41 [b]	4.95 ± 1.06 [a]	7.65 ± 0.62 [b]
Mousse D	6.00 ± 2.10 [a]	6.90 ± 1.66 [a]	6.18 ± 1.71 [a]	7.18 ± 1.41 [b]	5.15 ± 1.19 [b]	7.40 ± 0.87 [ab]
Mousse N	6.35 ± 1.56 [a]	6.90 ± 1.66 [a]	6.05 ± 1.61 [a]	5.10 ± 2.66 [a]	6.23 ± 1.69 [c]	7.00 ± 1.55 [a]
Mousse P	6.30 ± 1.57 [a]	6.90 ± 1.66 [a]	6.03 ± 1.81 [a]	5.10 ± 2.66 [a]	6.20 ± 1.71 [c]	7.65 ± 0.62 [b]
Mousse R	6.30 ± 1.57 [a]	6.90 ± 1.66 [a]	6.15 ± 1.63 [a]	7.18 ± 1.41 [b]	6.20 ± 1.73 [c]	7.25 ± 1.26 [ab]
Mousse X	6.20 ± 1.52 [a]	6.90 ± 1.66 [a]	6.08 ± 1.61 [a]	7.18 ± 1.41 [b]	6.20 ± 1.70 [c]	7.13 ± 1.22 [ab]

Different letters in the same column indicate significant differences ($p < 0.05$).

Mousses N and P were significantly different ($p < 0.05$), while other samples were not significantly different ($p > 0.05$) to the mousse control in terms of taste. Similar to bahulu, Mousses N and P were made using canned green pea liquids; thus, the mousses were slightly salty. From the result, it can be observed that all mousses' textures were acceptable to the panelists ($p < 0.05$), except for mousses A and D that were less acceptable compared to the control sample ($p < 0.05$). Mousses A's and D's slightly watery texture was coherent with their previous low-viscosity result of vegetable-liquid mousses. Therefore, it was less accepted by the consumers. The texture of mousse is important as it affects the consumers' acceptability and desire to buy it again [29]. Nevertheless, most panelists believed that if improvements were made towards the samples, they would be as good as the original or the control. Overall, the majority of the panelists provided positive feedback for the mousse samples as a whole ($p > 0.05$).

4. Conclusions

The results show that the canned pulse liquids have more potential to imitate egg whites in bahulu and chocolate mousse development compared to canned vegetable liquids. Bahulu N developed from canned green pea (pulse N) liquids had comparable hardness, fracturability, adhesiveness, springiness, cohesiveness, and chewiness qualities to egg white bahulu. Moreover, chocolate mousse produced from green pea (pulse N) liquid exhibited comparable viscosity to egg white mousse but contained less fat and higher carbohydrates. Despite having a positive effect on the texture profile and viscosity, green pea liquids had a significant impact on the color and taste of the products. However, both Bahulu N and mousse N, which used green pea liquids, demonstrated similar acceptance in terms of appearance, odor, texture, and overall acceptability as Bahulu and mousse controls.

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References

1. Campbell, G.M. Aerated Foods. In *Encyclopedia of Food and Health*; Elsevier: Amsterdam, The Netherlands, 2016; pp. 51–60.
2. Shin, M.; Han, Y.; Ahn, K. The influence of the time and temperature of heat treatment on the allergenicity of egg white proteins. *Allergy Asthma Immunol. Res.* **2013**, *5*, 96–101. [CrossRef]
3. Nastaj, M.; Mleko, S.; Terpiłowski, K.; Tomczy´nska-Mleko, M. Effect of Sucrose on Physicochemical Properties of High-Protein Meringues Obtained from Whey Protein Isolate. *Appl. Sci.* **2021**, *11*, 4764. [CrossRef]
4. Orrego, M.; Troncoso, E.; Zúñiga, R.N. Aerated whey protein gels as new food matrices: Effect of thermal treatment over microstructure and textural properties. *J. Food Eng.* **2015**, *163*, 37–44. [CrossRef]
5. Duquenne, B.; Vergauwen, B.; Capdepon, C.; Boone, M.A.; De Schryver, T.D.; Hoorebeke, L.V.; Weyenberg, S.V.; Stevens, P.; Block, J.D. Stabilising frozen dairy mousses by low molecular weight gelatin peptides. *Food Hydrocoll.* **2016**, *60*, 317–323. [CrossRef]
6. Rosniyana, A.; Hazila, K.K.; Hashifah, M.A.; Norin, S.A.S.; Zain, A.M. Nutritional composition and sensory properties of *kuih baulu* incorporated stabilised rice bran. *J. Trop. Agric. Food Sci.* **2011**, *39*, 1–9.
7. Murray, B.S. Recent developments in food foams. *Curr. Opin. Colloid Interface Sci.* **2020**, *50*, 101394. [CrossRef]
8. Duan, X.; Li, J.; Zhang, Q.; Zhao, T.; Li, M.; Xu, X. Effect of a multiple freeze-thaw process on structural and foaming properties of individual egg white proteins. *Food Chem.* **2017**, *228*, 243–248. [CrossRef]
9. Lomakina, K.G.; Míková, K. A study of the factors affecting the foaming properties of egg white—A review. *Czech J. Food Sci.* **2018**, *24*, 110–118. [CrossRef]
10. Kar, S. As Malaysia Faces Egg Shortage, PM Anwar Ibrahim Advises People against Panic Buying. Republicworld.com. Available online: https://www.republicworld.com/world-news/rest-of-the-world-news/as-malaysia-faces-egg-shortage-pm-anwar-ibrahim-advises-people-against-panic-buying-articleshow.html (accessed on 23 February 2023).
11. Shim, Y.Y.; Mustafa, R.; Shen, J.; Ratanapariyanuch, K.; Reaney, M. Composition and Properties of Aquafaba: Water Recovered from Commercially Canned Chickpeas. *J. Vis. Exp.* **2018**, *132*, 56305.
12. Amagliani, L.; Silva, J.V.C.; Saffon, M.; Dombrowski, J. On the foaming properties of plant proteins: Current status and future opportunities. *Trends Food Sci. Technol.* **2021**, *118*, 261–272. [CrossRef]
13. Stantiall, S.E.; Dale, K.J.; Calizo, F.S.; Serventi, L. Application of pulses cooking water as functional ingredients: The foaming and gelling abilities. *Eur. Food Res. Technol.* **2017**, *244*, 97–104. [CrossRef]
14. Mustafa, R.; He, Y.; Shim, Y.Y.; Reaney, M.J.T. Aquafaba, wastewater from chickpea canning, functions as an egg replacer in sponge cake. *Int. J. Food Sci. Technol.* **2018**, *53*, 247–2255. [CrossRef]
15. Donatus, F.; Sintang, M.D.; Julmohammad, N.; Noorakmar, A.W. Potential application of unconsumed liquid from commercial canned food products in fabrication and characterisation of non-dairy edible foam. *Int. J. Agric. For. Plant.* **2020**, *10*.
16. Treat Dreams. Chocolate Mousse (without Heavy Cream). Available online: https://treatdreams.com/chocolate-mousse-without-heavy-cream/ (accessed on 21 January 2023).
17. Hosseini Ghaboos, S.H.; Seyedain Ardabili, S.M.; Kashaninejad, M. Physicochemical, textural and sensory evaluation of sponge cake supplemented with pumpkin flour. *Int. Food Res. J.* **2018**, *25*, 854–860.
18. Stable Micro Systems. Texture: Measure and Analyse Properties Stable Micro Systems. Available online: https://www.stablemicrosystems.com/TextureAnalysisProperties.html (accessed on 23 January 2023).
19. Sheng, L.; Wang, Y.; Chen, J.; Zou, J.; Wang, Q.; Ma, M. Influence of high-intensity ultrasound on foaming and structural properties of egg white. *Food Res. Int.* **2018**, *108*, 604–610. [CrossRef]
20. AOAC. *Official Methods of Analysis*; Association of Official Analytical Chemists: Arlington, VA, USA, 2005.
21. Fernandes, S.S.; Filipini, G.; Salas-Mellado, M.d.l.M. Development of cake mix with reduced fat and high practicality by adding chia mucilage. *Food Biosci.* **2021**, *42*, 101148. [CrossRef]
22. Lawless, H.T.; Heymann, H. *Sensory Evaluation of Food: Principles and Practices*, 2nd ed.; Springer: New York, NY, USA, 2010.
23. Funami, T.; Nakauma, M. Instrumental food texture evaluation in relation to human perception. *Food Hydrocoll.* **2022**, *124*, 107253. [CrossRef]
24. He, Y.; Meda, V.; Reaney, M.J.T.; Mustafa, R. Aquafaba, a new plant-based rheological additive for food applications. *Trends Food Sci. Technol.* **2021**, *111*, 27–42. [CrossRef]
25. Hwang, J.; Shyu, Y.S.; Yeh, L.; Sung, W. Study on Sponge Cake Qualities Made from Hen, Duck and Ostrich Eggs. *J. Food Nutr. Res.* **2018**, *6*, 110–115. [CrossRef]
26. Wang, Z.; Zhang, S.; Vardhanabhuti, B. Foaming properties of whey protein isolate and λ-carrageenan mixed systems. *J. Food Sci.* **2015**, *80*, 1893–1902. [CrossRef] [PubMed]
27. Paula, A.M.; Conti-Silva, A.C. Texture profile and correlation between sensory and instrumental analyses on extruded snacks. *J. Food Eng.* **2014**, *121*, 9–14. [CrossRef]
28. Jiang, H.; Hettiararchy, N.S.; Horax, R. Quality and estimated glycemic profile of baked protein-enriched corn chips. *J. Food Sci. Technol.* **2019**, *56*, 2855–2862. [CrossRef]
29. Lu, R.; Cen, H. 8 Non-destructive methods for food texture assessment. In *Instrumental Assessment of Food Sensory Quality*; Woodhead Publishing: Sawston, UK, 2013; pp. 230–254.
30. Milner, L.; Kerry, J.P.; O'Sullivan, M.G.; Gallagher, E. Physical, textural, and sensory characteristics of reduced sponge cakes, incorporated with clean-label sugar-replacing alternative ingredients. *Innov. Food Sci. Emerg. Technol.* **2020**, *59*, 102235. [CrossRef]

31. Faber, T.J.; Jaishankar, A.; McKinley, G.H. Describing the firmness, springiness, and rubberiness of food gels using fractional calculus. Part II: Measurements on semi-hard cheese. *Food Hydrocoll.* **2017**, *62*, 325–339. [CrossRef]
32. StudyCorgi. Effects of Different Compounds on Egg White Foam Stability. Available online: https://studycorgi.com/effects-of-different-compounds-on-egg-white-foam-stability/ (accessed on 1 February 2023).
33. Nishinari, K.; Turcanu, M.; Nakauma, M.; Fang, Y. Role of fluid cohesiveness in safe swallowing. *NPJ Sci. Food* **2019**, *3*, 5. [CrossRef] [PubMed]
34. Hamedi, F.; Mohebbi, M.; Shahidi, F.; Azarpazhooh, E. Ultrasound assisted osmotic treatment of model food impregnated with pomegranate peel phenolic compounds: Mass transfer, texture and phenolic evaluations. *Food Bioprocess. Technol.* **2018**, *11*, 1061–1074. [CrossRef]
35. Kasapis, S.; Bannikova, A. Chapter 2—Rheology and food microstructure. In *Woodhead Publishing Series in Food Science, Technology and Nutrition*; Ahmed, J., Ptaszek, P., Basu, S., Eds.; Woodhead Publishing: Sawston, UK, 2017; pp. 7–46.
36. Herranz, B.; Canet, W.; Jimenez, M.J.; Fuentes, R.; Alvarez, M.D. Characterisation of chickpea flour-based gluten-free batters and muffins with added biopolymers: Rheological, physical and sensory properties. *Int. J. Food Sci. Technol.* **2016**, *51*, 1087–1098. [CrossRef]
37. Rahmati, N.F.; Tehrani, M.M. Influence of different emulsifiers on characteristics of eggless cake containing soy milk: Modeling of physical and sensory properties by mixture experimental design. *J. Food Sci. Technol.* **2014**, *51*, 1697–1710. [CrossRef]
38. Cardoso, R.V.C.; Fernandes, A.; Heleno, S.A.; Rodrigues, P.; Gonzalez-Paramas, A.M.; Barros, L.; Ferreira, I. Physicochemical characterization and microbiology of wheat and rye flours. *Food Chem.* **2019**, *280*, 123–129. [CrossRef]
39. Foschia, M.; Peressini, D.; Sensidoni, A.; Brennan, C.S. The effects of dietary fibre addition on the quality of common cereal products. *J. Cereal Sci.* **2013**, *58*, 216–227. [CrossRef]
40. Moore, S. Why is Moisture Content Analysis of Food Important? Available online: https://www.news-medical.net/life-sciences/Why-is-Moisture-Content-Analysis-of-Food-Important.aspx# (accessed on 29 January 2023).
41. Ludwig, D.S.; Hu, F.B.; Tappy, L. Dietary carbohydrate: Role of quality and quantity in chronic disease. *BMJ* **2018**, *361*, 2340. [CrossRef] [PubMed]
42. Ghanimah, M.; Ibrahim, E. Effect of pH, carbohydrates, and NaCl on functional properties of whey proteins. *J. Sustain. Agric. Sci.* **2018**, *44*, 93–99. [CrossRef]
43. Osilla, E.V.; Safadi, A.O.; Sharma, S. Calories. 2022. Available online: https://www.ncbi.nlm.nih.gov/books/NBK499909/ (accessed on 30 January 2023).
44. Nur Afifah, M.J.; Aishah, B. Effect of maltodextrin substitution on physicochemical and sensory properties of Malay traditional cake 'Bahulu'. *Int. J. Eng. Technol.* **2018**, *7*, 239–243. [CrossRef]
45. Zaitoun, M.; Ghanem, M.; Harphoush, S. Sugars: Types and their functional properties in food and human health. *Int. J. Public Health Research.* **2018**, *6*, 93–99.
46. Malnic, B.S.; Saraiva, L.R. Odor coding in the mammalian olfactory epithelium. *Cell Tissue Res.* **2021**, *383*, 445–456.
47. Péneau, S.; Hoehn, E.; Roth, H.-R.; Escher, F.; Nuessli, J. Importance and consumer perception of freshness of apples. *Food Qual. Prefer.* **2006**, *17*, 9–19. [CrossRef]
48. Clemson.edu. Available Moisture in Foods: What Is It Anyway? Available online: https://www.clemson.edu/extension/food/canning/canning-tips/39available-moisture.html (accessed on 23 January 2023).
49. Huppert, T. Milk Foam: Creating Texture and Stability. Available online: https://scanews.coffee/2014/09/15/milk-foam-creating-texture-and-stability/ (accessed on 23 January 2023).
50. Conti-Silva, A.C.; Ichiba, A.K.T.; Silveira, A.L.d.; Albano, K.M.; Nicoletti, V.R. Viscosity of liquid and semisolid materials: Establishing correlations between instrumental analyses and sensory characteristics. *J. Text. Stud.* **2018**, *49*, 569–577. [CrossRef]
51. Gray, D.; Abdel-Aal, E.M.; Seetharaman, K.; Kakuda, Y. Differences in viscosity and textural properties of selected barley cultivars as influenced by pearling and cooking. *Food Chem.* **2010**, *120*, 402–409. [CrossRef]
52. Akkouche, Z.; Aissat, L.; Madani, K. Effect of heat on egg white protein. In *International Conference on Applied Sciences*; IntechOpen: London, UK, 2012; pp. 407–413.
53. Vieira, J. Chocolate Aeration—Art or Science? New Food Magazine. Available online: https://www.newfoodmagazine.com/article/5415/chocolate-aeration-art-or-science/ (accessed on 29 January 2023).
54. Li, X.; Li, J.; Chang, C.; Wang, C.; Zhang, M.; Su, Y.; Yang, Y. Foaming characterization of fresh egg white proteins as a function of different proportions of egg yolk fractions. *Food Hydrocoll.* **2019**, *90*, 118–125. [CrossRef]
55. Ho, T.M.; Bhandari, B.; Bansal, N. Influence of milk fat on foam formation, foam stability and functionality of aerated dairy products. In *Dairy Fat Products and Functionality*; Springer: Cham, Switzerland, 2020; pp. 583–606.
56. Massoud, R.; Hosseini, A.H.; Massoud, A. Functional properties of food proteins; gelation and stable foam. In Proceedings of the 6th International Conference on Science and Engineering (ICES), Paris, France, 7 December 2017; pp. 1–8.
57. Hou, Q.; Xiwen, W. Effect of fiber surface characteristics on foam properties. *Cellulose* **2018**, *25*, 3315–3325. [CrossRef]
58. Mozaffarian, D. Food and weight gain: Time to end our fear of fat. *Lancet Diabetes Endocrinol.* **2016**, *4*, 633–635. [CrossRef] [PubMed]