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Characteristics of Restructured Mackerel Meat Jerky (Study of Mackerel Meat Proportion: Young Jackfruit) and Addition of Na-Alginate

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A B S T R A C T

Restructured jerky is a processed ground meat product made by binding small pieces of meat together using binders like Na-Alginate. This study aimed to determine the optimal combination of mackerel and young jackfruit proportions with Na-Alginate to produce high-quality restructured jerky. The study was structured with a completely randomized design (CRD) incorporating a two-factor factorial arrangement and two replications. Factor I varied the proportions of mackerel to young jackfruit (65:35, 50:50, 35:65), and Factor II varied the Na-Alginate addition (0.25%, 0.50%, 0.75%). The data was subjected to analysis of variance followed by post-hoc testing using Duncan's Multiple Range Test (DMRT). The best result was obtained with a mackerel to young jackfruit ratio of 65:35 and 0.50% Na-Alginate, resulting in restructured jerky with the following characteristics: 8.02% water content, 0.44% ash content, 2.32% crude fiber, 42.20% yield, 0.47% a_w, 22.84% protein content, 2.98% fat content, and a hedonic organoleptic test score for color (3.56, like), aroma (3.00, like), taste (3.16, like), and texture (3.16, like).

1. INTRODUCTION

1.1. Research Background

Dendeng is a well-known meat preservation product among Indonesians. It can be produced using restructuring techniques, which involve reprocessing small and irregular meat pieces into products that resemble whole meat by adding *binding agents* or natural proteins [1]. In this study, mackerel was used as a substitute for beef. Mackerel has a greater protein content (22 grams) compared to other types of fish [2], but its potential has not been fully utilized. Without immediate processing, mackerel's quality declines, necessitating further processing to maintain its quality and extend its shelf life [3]

Creating restructured jerky from mackerel meat does not yield a fibrous texture like beef jerky. However, the fibrous texture of young jackfruit can be utilized to create the desired fibrous texture in mackerel-based restructured jerky. Since young jackfruit lacks the connective tissues found in meat, such as collagen, elastin, and reticulin fibers [4], a binder is necessary in the production of restructured jerky..

The added *binder* is Na-alginate. Alginate components can form complex interactions with proteins and water so that these components can produce strong gel properties [5]. Gel formation will be formed when alginate reacts with calcium ions, both of which will extract proteins, form gels, and hold the release of water and fat from the meat [6]. The results of research [7], showed that the addition of 0.50% Na-Alginate gave the best texture in the manufacture of restructured jerky bamboo shoots and dried anchovies.

1.2. Literature Review

According to [8] the high nutritional content of mackerel in 100 grams is 22 g protein, 1 g fat, 20 mg calcium, 200 mg phosphorus, 103 kcal energy and 1 mg iron. The nutritional benefits of mackerel can serve as the foundation for producing restructured jerky. However, since the texture of mackerel-based restructured jerky is less fibrous, incorporating young jackfruit, known for its fibrous texture, becomes essential. Not only does young jackfruit resemble the fibrous appearance of beef, but its fiber content also facilitates water binding, consequently influencing the water content of the end product [9].

According to [10] in 100 grams of young jackfruit contains a nutritional value of total food fibre 8.45 g, protein 2 g, fat 0.4 g, carbohydrate 11.3 g, calcium 45 mg, phosphorus 29 mg, energy 57 kcal, and potassium 0.5 mg.

The general stages of making restructured jerky according to [11] include mixing meat with spices and binders, moulding on baking sheets, and drying in a *cabinet dryer*. In the production of restructured products, binders play a crucial role. Na-Alginate, upon mixing with meat, undergoes gel formation, effectively binding the meat flakes together. This gel formation is initiated by the addition of Ca salts to the Na-Alginate solution. Ca-Lactate is among the Ca salts that can be introduced. The chemical process responsible for gel formation involves Ca displacing sodium from alginate and subsequently binding to the elongated alginate molecules [12].

1.3. Research Objective

This research seeks to identify the optimal blend of mackerel meat and young jackfruit, alongside the incorporation of Na-Alginate, to create restructured jerky that meets high quality standards and aligns with consumer preferences.

2. MATERIALS AND METHODS

2.1. Materials and Tools

The components employed include mackerel flesh, tender jackfruit, Na-Alginate, Ca-Lactate, brown sugar, pepper, cilantro, galangal, tamarind extract, shallots, garlic, and salt, along with H2SO4, NaOH, K2SO4, distilled water, alcohol, and petroleum benzene..

The tools used in making restructured jerky include *cabinet dryer*, analytical scales, *chopper*, baking tray, weighing bottle, oven, furnace, desiccator, aw meter, kjeldahl flask, pipette, erlenmeyer, filter paper, soxhlet, counter cooler, beaker glass, and measuring cup.

2.2. Design of Experiment and Analysis

This study employed a fully randomized design (CRD) with a two-factor factorial arrangement and 2 replications. Factor I involved varying proportions of mackerel meat to young jackfruit (65:35, 50:50, 35:65) (w/b), while factor II entailed the inclusion of Na-Alginate at different levels (0.25%, 0.50%, and 0.75%) (w/b). The specific treatment combinations utilized in this study are detailed in Table 1.

Table 1. Treatment combinations of restructured jerky

Mackerel meat: young jackfruit	Na-Alginate Addition		
	B1	B2	B3
A1	A1B1	A1B2	A1B3
A2	A2B1	A2B2	A2B3
A3	A3B1	A3B2	A3B3

Description:
A1B1 = Proportion of mackerel meat: young jackfruit (65%:35%) and addition of 0.25% Na-Alginate
A1B2 = Proportion of mackerel meat: young jackfruit (65%:35%) and addition of 0.50% Na-Alginate
A1B3 = Proportion of mackerel meat: young jackfruit (65%:35%) and addition of 0.75% Na-Alginate
A2B1 = Proportion of mackerel meat: young jackfruit (50%:50%) and addition of 0.25% Na-Alginate
A2B2 = Proportion of mackerel meat: young jackfruit (50%:50%) and addition of 0.50% Na-Alginate
A2B3 = Proportion of mackerel meat: young jackfruit (50%:50%) and addition of 0.75% Na-Alginate
A3B1 = Proportion of mackerel meat: young jackfruit (35%:65%) and addition of 0.25% Na-Alginate
A3B2 = Proportion of mackerel meat: young jackfruit (35%:65%) and addition of 0.50% Na-Alginate
A3B3 = Proportion of mackerel meat: young jackfruit (35%:65%) and addition of 0.75% Na-Alginate

Products were analysed using ANOVA and followed by *Duncan Multiple Range Test* (DMRT) at the 5% significance level. The statistical analysis obtained was processed using IBM SPSS Statistics Version 23 software. Sensory results data were analysed using *Friedman*.

2.3. Procedure

2.3.1 Research Procedures

The procedure for making restructured jerky refers to research [7], first the meat of mackerel and young jackfruit is weighed according to the treatment (65:35, 50:50, 35:65), then the addition of spices including 20% brown sugar, 2.5% salt, 2.5% coriander, 1.5% garlic, 2.5% shallots, 10% tamarind, 2% pepper, and 3.5% galangal. Following that, Na-Alginate was incorporated based on the designated proportions (0.25%, 0.50%, 0.75%), along with 0.50% Ca-lactate. Subsequently, the mixture was left to rest, enabling the Na-Alginate to form a gel, facilitating the binding of the fish meat with the tender jackfruit. The formed dough was shaped on a baking tray and further dried in a cabinet dryer at 60°C for 6 hours.. After drying, the jerky was removed from the *cabinet dryer*.

2.3.2 Raw Material Analysis

The examination of mackerel raw materials includes the evaluation of the moisture content, ash content, protein content, and fat content percentages. Similarly, the analysis of young jackfruit entails assessing the moisture content, ash content, crude fiber, protein content, fat content, and dietary fiber percentages.

2.3.3 Chemical Analysis of Restructured Jerky

The parameters for evaluating restructured jerky include yield percentage, moisture content, ash content, crude fiber content, protein content, fat content, and water activity.

2.3.4 Sensory Analysis of Restructured Jerky

Sensory attributes analysed in the restructured jerky organoleptic test included aroma, texture, taste and colour. This test was conducted using the *hedonic scale scoring* method and analysed using the *Friedman* test.

3 RESULT AND DISCUSSION

3.1 Chemical Analysis

3.1.1 Raw Material Analysis

The analysis results of mackerel and young jackfruit meat raw materials are presented in Table 2. According to Table 2, mackerel meat contains 71.59% moisture, 1.39% ash, 20.16% protein, and 1.33% fat. In accordance with [13] the composition of mackerel has a water content of 76.00%, protein content of 22.00% and fat content of 1.00%. [14] added that mackerel has an ash content of 1.48%,

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Table 2 also indicates that young jackfruit has a moisture content of 82.00%, an ash content of 0.83%, 3.52% crude fiber, 1.90% protein, 0.19% fat, and 6.83% dietary fiber. Consistent with [15], young jackfruit contains 85.4% moisture, 0.9% ash, 2.0% protein, and 0.4% fat. According to [16], young jackfruit has acrude fiber content of 3.39%, and as stated by [10], its total dietary fiber content is 8.45%.

3.1.2. Yield

The analysis of variance findings revealed a notable interaction ($p \leq 0.05$) among the ratios of ground mackerel meat to ground young jackfruit in the treatment and the incorporation of Na-Alginate on the yield of the resulting restructured jerky. Additionally, each treatment independently had a significant impact on the yield. The relationship among the proportion of ground mackerel meat to ground young jackfruit and the addition of Na-Alginate is illustrated in Figure 1.

Figure 1 illustrates that the average yield of restructured jerky ranges from 38.48% to 42.24%. The yield increases with a greater proportion of mackerel meat, a lower proportion of young jackfruit, and a greater addition of Na-Alginate. This is attributed to mackerel's high total solids content, which influences the final product's weight. According to [17], the increase in yield is caused by the material to be dried containing high total solids so that the yield resulting from the drying process is also greater. In accordance with [7] in research on the manufacture of restructured jerky bamboo shoots and fresh anchovies with the addition of alginate states that high total solids will increase the yield value produced. According to research [18] on the manufacture of mackerel jerky produced a yield of mackerel jerky of 1.89%.

The greater the addition of Na-Alginate, the greater the yield of restructured jerky. This is because Na-Alginate has the ability to bind water so that the resulting yield value will be greater. [19] added that the yield of catfish jerky will increase with the addition of alginate, this is because Na-Alginate has the ability to bind water by producing a gel that causes water to be trapped in the jerky.

3.1.3 Water content

The analysis of variance revealed a substantial interaction ($p \leq 0.05$) among the treatment involving the ratio of ground mackerel meat to ground young jackfruit and the incorporation of Na-Alginate on the moisture content of the restructured jerky manufactured. Similarly, each treatment significantly affected the water content. The relationship among the proportion of mackerel meat: young jackfruit and the addition of Na-alginate is shown in Figure 2.

Figure 2 illustrates the varying moisture content levels of restructured jerky, ranging from 7.86% to 13.17%. It is evident that a decrease in the mackerel meat ratio, accompanied by an increase in young jackfruit content and Na-Alginate addition, results in greater water content within the restructured jerky. This is because young jackfruit has a greater water content (82.00%) compared to mackerel (71.59%). In addition, the fibre content in young jackfruit (3.52%) which is able to bind water, which is difficult to release during the drying stage can affect the moisture content of the final product. In accordance with research [9] that the high fibre content in the material is able to absorb and bind water quickly in large quantities.

The greater the addition of Na-Alginate, the greater the water content of restructured jerky. This is because Na-Alginate has the ability to bind water. Alginate is a polysaccharide compound consisting of mannuronic and guluronic groups, these compounds are able to bind water and form a strong gel [20]. In accordance with [5] the alginate component can form complex interactions with proteins and water so that these components can produce strong gel properties.

3.1.4 Ash content

The analysis of variance findings revealed a lack of significant interaction ($p \geq 0.05$) among the ratio of ground mackerel meat to ground young jackfruit, when combined with Na-Alginate, on the ash content of the restructured jerky products. However, both the proportion of mackerel meat to young jackfruit and the addition of Na-Alginate independently had a significant effect ($p \leq 0.05$) on the ash content of the restructured jerky.

The average ash content of restructured jerky made from varying proportions of ground mackerel meat and ground young jackfruit is presented in Table 3. The ash content ranges among 0.29% and 0.45%, as shown in the table. The results indicate that increasing the proportion of mackerel meat and decreasing the proportion of young jackfruit results in greater ash content in the jerky. This trend is attributed to the greater ash content in mackerel meat (1.39%) compared to that in young jackfruit (0.83%). According to [21], ash content is related to the amount of minerals contained in food ingredients such as phosphorus, potassium, and calcium. [22] added that mackerel contains 200.00 mg of phosphorus, and 20.00 mg of calcium.

The addition of Na-Alginate significantly impacted the ash content of restructured jerky. Table 4 presents the average ash content values for the Na-Alginate addition treatment, ranging from 0.35% to 0.40%. The data indicate that increasing the amount of Na-Alginate results in greater ash content in the jerky. This is due to the high ash content of Na-Alginate itself, which influences the overall ash content of the restructured jerky. The high and low ash content is caused by salts and minerals, in accordance with [23] which states that the ash content contained in Na-Alginate shows the presence of mineral salts with a value around 18.02%.

3.1.5 Coarse Fibre

The analysis of variance unveiled a notable interaction ($p \leq 0.05$) among the ratio of ground mackerel meat to ground young jackfruit and the incorporation of Na-Alginate on the crude fiber content of the restructured jerky. Both treatments individually also had a significant effect on the crude fiber content. Figure 3 illustrates the relationship among the proportion of ground mackerel meat to ground young jackfruit and the addition of Na-Alginate.

Figure 3 illustrates that the mean crude fiber concentration in restructured jerky varies among 2.26% and 3.62%. Consequently, as the percentage of ground mackerel meat diminishes and the percentage of ground young jackfruit and Na-Alginate increases, the crude fiber content of the jerky escalates. This is due to mackerel being an animal-based food source that lacks crude fiber, whereas young jackfruit, a plant-based food source, contains crude fiber. In accordance with [24] which states that young jackfruit is composed of cellulose which is a fibre component. The crude fibre content of young jackfruit in this study was (3.52%), while in research [16] young jackfruit contained crude fibre of (3.39%).

The greater the addition of Na-Alginate, the greater the crude fibre of restructured jerky. This is because Na-Alginate contains

crude fibre, according to [23] the crude fibre content in Na-Alginate is 9.57%. In accordance with [6] that the increase in crude fibre content is caused by one of the main properties of alginate which has the ability to form fibres in the form of calcium alginate. Therefore, the greater the concentration of alginate added, the fibre formed in the final product will increase.

3.1.6 Protein Content

The variance analysis indicated a significant interaction ($p \leq 0.05$) among the proportion of ground mackerel meat to ground young jackfruit and the addition of Na-Alginate on the protein content of the restructured jerky. Each treatment also had a significant effect on the protein content individually. Figure 4 depicts the relationship among the proportion of ground mackerel meat to ground young jackfruit and the addition of Na-Alginate.

Figure 4 illustrates that the average protein content of restructured jerky ranges from 16.43% to 23.15%. As the proportion of mackerel meat decreases and the proportions of young jackfruit and Na-Alginate increase, the protein content of the jerky decreases. This trend is due to mackerel having a greater protein content (20.16%) compared to young jackfruit (1.90%). In accordance with [25] which states that the value of protein content produced affects the amount of fish concentration added. [26] added that the decrease in the value of protein content can be caused by the hydrophobic nature of proteins that can bind fat.

The greater the addition of Na-Alginate, the lower the protein content of restructured jerky. This is because Na-Alginate contains a low protein content of 0.82%. [23]. Alginate is a hydrocolid compound that is able to form complex bonds with protein and water so that it can form strong gel characteristics [5].

3.1.7 Fat content

The results from the analysis of variance revealed that there was no statistically significant interaction ($p \geq 0.05$) between the ratio of ground mackerel meat to ground young jackfruit and the inclusion of Na-Alginate on the fat content of restructured jerky. While the proportion of mackerel meat to young jackfruit had a significant effect, the addition of Na-Alginate did not significantly affect the fat content.

Table 5 presents the average fat content of restructured jerky for the different proportions of ground mackerel meat and ground young jackfruit, which ranged from 1.97% to 2.96%. The data showed that increasing the proportion of mackerel meat and decreasing the proportion of young jackfruit resulted in greater fat content in the jerky. This is due to mackerel having a greater fat content (1.33%) compared to young jackfruit (0.19%). The fat content in the raw materials directly influences the fat content of the restructured jerky..

The incorporation of Na-Alginate did not yield any substantial impact on the fat composition of the restructured jerky. The mean fat percentage resulting from the Na-Alginate addition treatment is detailed in Table 6, revealing a fat content range of 2.30-2.65%. The treatment of Na-Alginate addition did not give a significant effect due to the relatively small fat content in Na-Alginate. According to [23] the fat content in Na-Alginate is 0.09%. According to [27] alginate is a hydrocolloid that will interact with protein so that it can form a gel.

3.1.8 a_w

Water activity (a_w) is the available water content that microorganisms can utilize for their proliferation [28]. The analysis of variance indicated that there was no significant correlation ($p \geq 0.05$) between the ratio of ground mackerel meat to ground young jackfruit and the inclusion of Na-Alginate on the water activity (a_w) of restructured jerky. However, both the proportion of ground mackerel meat to ground young jackfruit and the Na-Alginate addition treatments individually had a significant effect ($p \leq 0.05$) on the aW of the restructured jerky..

The average water activity (a_w) values of restructured jerky for different proportions of ground mackerel meat and ground young jackfruit are presented in Table 7. The a_w of the jerky ranges from 0.33 to 0.47, as shown in the table. As the proportion of mackerel meat decreases and the proportion of young jackfruit increases, the a_w decreases. This is attributed to young jackfruit having a greater water content compared to mackerel, indicating greater levels of both free and bound water. In accordance with [29] which states that the greater the moisture content of a food ingredient, the more water that evaporates during the drying process, the water that can evaporate is included in the class of free water that is not strongly bound.

The addition of Na-Alginate significantly impacted the water activity (a_w) of restructured jerky. Table 8 shows the average aW values for the Na-Alginate addition treatment, which range from 0.37 to 0.43. The data indicate that as the amount of Na-Alginate increases, the a_w of the restructured jerky decreases. This effect is due to the water-binding properties of Na-Alginate, which reduce the amount of free water in the food ingredients.

3.2 Sensory Analysis

3.2.1 Texture

Table 10 shows that the highest level of liking from panellists towards the texture of restructured jerky was obtained in the treatment of the proportion of 65% mackerel meat and 35% young jackfruit and the addition of 0.50% Na-alginate with an average value of 3.16 (like). This is because the treatment uses a greater proportion of mackerel (65%) compared to the proportion of young jackfruit (35%) so that the resulting texture is dense and not brittle. The fibre content in young jackfruit makes the jerky produced a little brittle. According to [16] young jackfruit contains 3.39% fibre, so the addition of mackerel will produce a more compact jerky texture.

The treatment of 0.50% Na-Alginate addition produced the highest liking value with an average of 3.16 (like) from panellists towards the texture of restructured jerky. This is because Na-Alginate can form a gel in restructured jerky products so that the resulting texture becomes stronger. In accordance with [30] that the addition of Na-Alginate in jerky will produce a strong texture.

3.2.2 Flavour

Table 10 reveals that the highest level of liking among panelists for the taste of restructured jerky was achieved with a treatment consisting of 65% mackerel meat, 35% young jackfruit, and 0.50% Na-Alginate, resulting in an average rating of 3.16 (like). This preference is attributed to the greater proportion of mackerel (65%) in this treatment compared to others, as mackerel imparts a distinct savory fish flavor, preventing the product from being bland. This is supported by [31] which states that animal food such as mackerel contains protein (22%) and fat (1%) which can produce a savoury and delicious taste. While young jackfruit contains protein (2%) and fat (0.4%) which is lower than mackerel but has fibre (3.39%) so that the taste of young jackfruit tends to be bland and does not affect the taste of restructured jerky.

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The treatment of 0.50% Na-Alginate addition resulted in the highest liking value from panellists with an average of 3.16 (like) towards the taste of restructured jerky. The treatment of alginate addition did not affect the taste of restructured jerky. This is inaccordance with [32] which states that alginate flour does not affect the taste of restructured jerky products. The taste of restructured jerky will be influenced by the addition of spices such as brown sugar, salt, coriander, or galangal.

3.2.3 Aroma

Table 10 indicates that the highest level of panelist liking for the aroma of restructured jerky was achieved with a treatment consisting of 50% mackerel meat, 50% young jackfruit, and 0.75% Na-Alginate, receiving an average rating of 3.56 (like). This preference is due to the treatment resulting in a neutral, non-fragrant aroma. According to [33], mackerel contains hydrogen disulfide, methyl mercaptan, and dimethyl sulfide, giving the product a fishy aroma. [34] added that the aroma in jerky comes from volatile compounds found in fish meat and added spices. Volatile compounds are compounds that easily evaporate when there is an increase in temperature [35].

The addition of 0.75% Na-Alginate resulted in the highest aroma liking value from panelists, with an average rating of 3.56 (like) for the restructured jerky. The Na-Alginate addition treatment did not significantly affect the aroma of the restructured jerky.. According to [36] hydrocolloids do not contain volatile ingredients that can cause aroma or colour in the final product. According to [37] the addition of spices to jerky can reduce rancidity and can give a distinctive aroma to the jerky produced. In making jerky, the Maillard reaction occurs which gives rise to the aroma of jerky.

3.2.4 Colour

Table 10 reveals that the highest level of panelist liking for the aroma of restructured jerky was achieved with a treatment consisting of 65% mackerel meat, 35% young jackfruit, and 0.75% Na-Alginate, receiving an average rating of 3.68 (like). This is due to the proportion of young jackfruit added which is less than the other treatments. Young jackfruit has a slightly yellowish-white colour [38] so that when added with fish the resulting colour becomes dark brown. [26] added that the heating process resulted in a brown colour change in jerky due to the Maillard reaction. The Maillard reaction is a reaction among reducing sugars and amino acids that act due to heating. The Maillard reaction is important in the formation of flavour and colour in food products.

The addition of 0.75% Na-Alginate resulted in the highest color liking value from the panelists, with an average rating of 3.56 (like) for the restructured jerky. The Na-Alginate addition treatment did not significantly affect the color of the restructured jerky. According to [36] hydrocolloids do not contain volatile ingredients that can cause colour or aroma in the final product.

4 CONCLUSION

The treatment with a proportion of 65% mackerel meat and 35% young jackfruit, along with the addition of 0.50% Na-Alginate, was identified as the best method for producing restructured jerky. This treatment resulted in jerky with 8.02% moisture content, 0.44% ash content, 2.32% crude fiber, 42.20% yield, 0.47 Aw, 22.84% protein content, 2.98% fat content, a color rating of 3.56 (like) in the hedonic organoleptic test, aroma rating of 3.00 (like), taste rating of 3.16 (like), and texture rating of 3.16 (like).

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Table 2: Raw material analysis results

Parameters	Raw materials	
	Mackerel	Young Jackfruit
Water Content (%)	71.59 ± 0.14	82.00 ± 0.19
Ash Content (%)	1.39 ± 0.14	0.83 ± 0.01
Crude Fibre (%)	-	3.52 ± 0.14
Protein Content (%)	20.16 ± 0.26	1.90 ± 0.25
Fat Content (%)	1.33 ± 0.05	0.19 ± 0.08
Dietary Fibre (%)	-	6.83 ± 0.83

Table 3. Average value of ash content of restructured jerky in the treatment of mackerel and young jackfruit meat proportion

Mackerel Meat: Young Jackfruit (%)	Ash Content (%) ± SD	DMRT	Notation
65 : 35	0,45 ± 0,03	0,04	c
50 : 50	0,37 ± 0,03	0,04	b
35 : 65	0,29 ± 0,02	-	a

Notes: Mean values accompanied by different letters indicate significant differences p≤0.05

Table 4. Average value of ash content of restructured beef jerky in Na-Alginate addition treatment

Na-Alginate Addition (%)	Ash Content (%) ± SD	DMRT	Notation
0,25	0,35 ± 0,08	-	a
0,50	0,36 ± 0,08	0,41	a
0,75	0,40 ± 0,08	0,42	b

Notes: Mean values accompanied by different letters indicate significant differences p≤0.05

Table 5. Mean value of fat content of restructured jerky in the treatment of mackerel and young jackfruit meat proportion

Mackerel Meat: Young Jackfruit (%)	Fat Content (%) ± SD	DMRT	Notation
65 : 35	2,96 ± 0,09	0,53	c
50 : 50	2,52 ± 0,23	0,51	b
35 : 65	1,97 ± 0,21	-	a

Notes: Mean values accompanied by different letters indicate significant differences p≤0.05

Table 6. Average value of fat content of restructured beef jerky in Na-Alginate addition treatment.

Na-Alginate Addition (%)	Fat Content (%) ± SD	DMRT	Notation
0,25	2,30 ± 0,56	-	a
0,50	2,50 ± 0,49	0,51	ab
0,75	2,65 ± 0,45	0,53	b

Notes: Mean values accompanied by different letters indicate significant differences p≤0.05

Table 7. Average value of a_w value of restructured jerky in the treatment of the proportion of mackerel meat and young jackfruit.

Mackerel Meat: Young Jackfruit (%)	Mean a_w (%) ± SD	DMRT	Notation
65 : 35	0,47 ± 0,04	0,02	c
50 : 50	0,38 ± 0,03	0,02	b
35 : 65	0,33 ± 0,02	-	a

Notes: Mean values accompanied by different letters indicate significant differences p≤0.05

\Table 8. Mean value of a_w value of restructured jerky in Na-Alginate addition treatment Notes: Mean values accompanied by different letters indicate significant differences p≤0.05

Sample	Parameters						
	Yield (%)	Water Content (%)	Ash Content (%)	Crude Fibre (%)	Protein Content (%)	Fat Content (%)	aW
A1B1	42.17	7.86	0.42	2.26	23.15	2.87	0.52
A1B2	42.20	8.02	0.44	2.32	22.84	2.98	0.47
A1B3	42.24	8.56	0.48	2.41	22.69	3.05	0.44
A2B1	40.14	9.19	0.34	2.67	20.66	2.28	0.41
A2B2	40.56	10.17	0.36	2.91	20.31	2.54	0.39
A2B3	41.51	11.12	0.40	3.07	19.87	2.73	0.36
A3B1	38.48	11.71	0.27	3.24	18.00	1.74	0.35
A3B2	39.77	12.53	0.29	3.40	17.51	2.00	0.33
A3B3	40.05	13.17	0.31	3.62	16.43	2.17	0.31

Table 9. Chemical analysisof restructured jerky

Na-Alginate Addition (%)	Mean a_w ± SD	DMRT	Notation
0,25	0,43 ± 0,08	0,02	c
0,50	0,39 ± 0,07	0,02	b
0,75	0,37 ± 0,06	-	a

Table 10. Sensory analysis of restructured jerky

Sample	Sensory analysis			
	Texture	Flavour	Aroma	Colour
A1B1	3.12	3.04	3.36	3.48
A1B2	3.16	3.16	3.00	3.56
A1B3	3.08	2.92	2.88	3.68
A2B1	2.84	3.00	3.20	3.32
A2B2	2.96	3.12	3.44	3.32
A2B3	2.80	3.00	3.56	3.36
A3B1	2.52	2.96	3.28	3.52
A3B2	2.72	3.08	3.36	3.24
A3B3	2.9	2.80	2.96	3.20

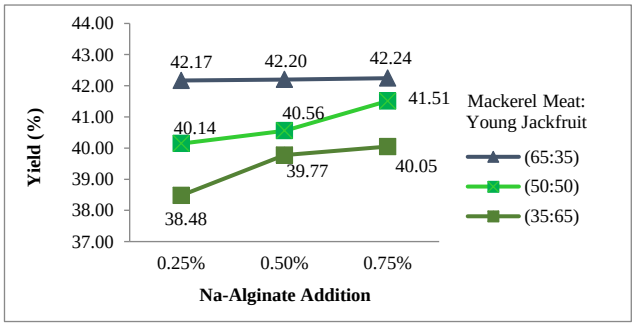

Fig. 1. Relationship among the proportion of mackerel meat: young jackfruit and Na-Alginate addition on the yield of restructured jerky

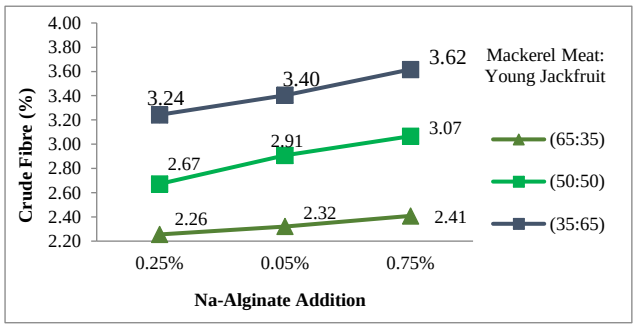

Fig. 3. Relationship among the proportion of mackerel meat: young jackfruit and Na-Alginate addition on crude fibre of restructured jerky

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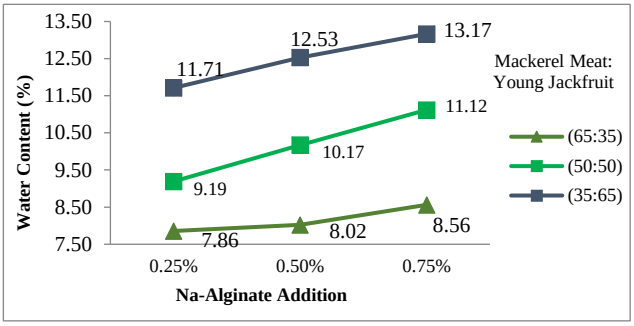

Fig. 2. Relationship among the proportion of mackerel meat: young jackfruit and Na-Alginate addition on the moisture content of restructured jerky

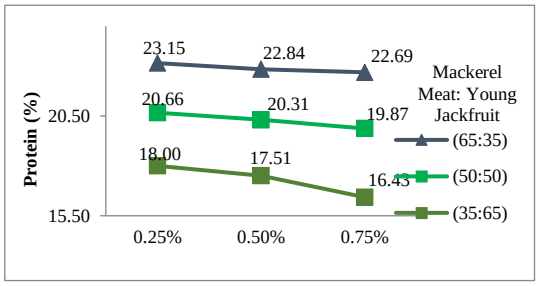

Fig. 4. Relationship among the proportion of mackerel meat: young jackfruit and the addition of Na-Alginate on the protein content of restructured jerky.