Improving the Physicochemical and Microstructural Qualities of Chicken Patties with the Addition of Red Beet Peel Flour (*Beta vulgaris* L) as a Filler

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**ABSTRACT**: Chicken patties are one of the processed products that have a low fiber content and pale color, and are easily rancid because there are no added preservatives. This study aimed to determine the physicochemical and microstructural qualities of chicken patties using red beet peel flour (RBPF) as a source of fiber to increase the added value of RBPF. This research was conducted using experimental laboratory methods with a completely randomized design with 4 treatments and 4 replications. Treatment without the use of RBPF as a control (CP0), 1% (CP1), 2% (CP2), and 3% (CP3) used beetroot flour of the weight of material used. The variables measured were carbohydrates, texture, pH, fiber, organoleptic quality, and microstructure. Analysis of variance (ANOVA) was used as data analysis if there were differences in effect between the treatments, followed by Duncan's Multiple Range Test (DMRT). Using RBPF in chicken patties can improve the quality of chicken patties. The higher the use of RBPF, the higher the carbohydrate content, texture, and fiber, and lowered the pH of the patties. Panelists gave the highest rating score the higher the addition of RBPF in terms of color, taste, aroma, texture, and acceptability. The addition of RBPF with the best treatment was 3%. Based on the physicochemical quality, organoleptic quality, and microstructure, those addition has excellent nutritional content and RBPF which can be used to improve the texture of processed food products.

**Keywords**: Patties; Chicken meat; Beet peel flour; Filler

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INTRODUCTIONS

Chicken meat is the primary source of protein at this time due to its high nutritional content and affordable prices for various groups of people. Chicken is known to have many health benefits as it is nutritious, high in protein, and low in cholesterol, calories, and fat (Kim et al., 2020). Also, chicken is cheaper than other meats like pork, beef, and lamb (Sujiwo, Kim, and Jang, 2018). Chicken consumption (especially breast meat) is expected to increase due to health awareness and demand for low-protein foods (Kim et al., 2020). Changes in chicken meat due to oxidative rancidity can differ, ranging from a slight loss of freshness to a significant change in flavor, loss of color, and protein breakdown (Sharma and Yadav, 2020). Chicken meat is a perishable food ingredient that requires handling and preservation to extend its shelf life. The use of meat restructuring technology is one of the right choices in processing chicken meat. The value added by the carcass cuts in chicken meat restructuring increased due to uneconomical and underutilized. The principle of restructured meat is to use relatively small pieces that are not irregular and then put them back together into a product that resembles whole meat (Fang, Lin, and Warner, 2019). Chicken meat restructuring products include meatballs, sausages, nuggets, and burgers or patties.

Patties are a processed meat product generally found in fast food restaurants. Chicken patties have advantages over other poultry meat based on the texture of hardness and elasticity, but the patties on the market have a high-fat content (Unzil, Azlan, and Sultana, 2021). The weakness of the restructuring process is the critical system, texture, filler, binder, and color (Das, Rajkumar, and Verma, 2015). Besides, some things need to be improved in the patties product which are low fiber, the pale color that is less attractive, easy to experience rancidity, texture, and nutritional quality. Beet peel is a by-product of agro-industrial products that can be reused. Agro-industrial wastes such as seeds and peels still contain active compounds that can be utilized in processing meat products, such as vitamins, total phenolics, dietary fiber, and carotenoids (Ali, Ibrahim, and Mostafa, 2022). Beets belong to the Chenopodiaceae family and have a color that varies from yellow to red.

Beet peel contains betacyanin compounds which can be used as natural dyes (Silalahi et al., 2022). Beet peel is a source of antioxidants because of several active compounds such as carotenoids, glycine betaine, saponins, and folate from betacyanin and betalain polyphenols and flavonoids (El-Beltagi et al., 2022). Beetroot powder has been used to manufacture sausages as an alternative to nitrites (Sucu and Turp, 2018). With the use of red beet peel flour (RBPF) as a filler and a source of fiber, the physicochemical quality of chicken patties is expected to improve. This study aimed to determine the quality of chicken patties using RBPF in terms of carbohydrates, texture, pH, fiber, organoleptic quality, and microstructure.

MATERIALS AND METHODS

Research material

The research material used in this study was chicken patties made from breast chicken meat and other ingredients, including tapioca flour, egg whites, pepper, onions, garlic, salt, sugar, and mushroom broth. Addition of beet peel flour to chicken patties according to the treatment. The material for analysis used samples of chicken patties by adding different amounts of beet peel flour.

Research methods

A completely randomized four-treatment and four-replication design was used in this study as the research method. RBPF was added at different percentages in this study as the treatment. Control treatment (without the addition of RBPF) (CP0), the addition of 1% RBPF (CP1), the addition of 2% RBPF (CP2), and the addition of 3% RBPF (CP3) of the weight of material used. Formula chicken patties can be seen in Table 1.
Table 1. Chicken Patties Formula with RBPF

<table>
<thead>
<tr>
<th>Ingredients (%)</th>
<th>CP0</th>
<th>CP1</th>
<th>CP2</th>
<th>CP3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken meat</td>
<td>70</td>
<td>70</td>
<td>70</td>
<td>70</td>
</tr>
<tr>
<td>Ice</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Flour</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Garlic</td>
<td>1.125</td>
<td>1.125</td>
<td>1.125</td>
<td>1.125</td>
</tr>
<tr>
<td>Onion</td>
<td>2.25</td>
<td>2.25</td>
<td>2.25</td>
<td>2.25</td>
</tr>
<tr>
<td>Salt</td>
<td>0.75</td>
<td>0.75</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>Egg whites</td>
<td>0.75</td>
<td>0.75</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>Pepper</td>
<td>0.75</td>
<td>0.75</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>Powder broth</td>
<td>0.75</td>
<td>0.75</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>CMC</td>
<td>0.75</td>
<td>0.75</td>
<td>0.75</td>
<td>0.75</td>
</tr>
<tr>
<td>Beet peel flour</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Procedure for Making Red Beet Peel Flour
The procedure for making flour begins with the selection of beet peels which will be processed into flour selected with clean criteria, no spots, and mold. The beet peel is washed using running water, then cut into smaller sizes so that the heat can be absorbed evenly during the drying process. The beet peel is dried using an oven with a temperature of 60 ± 2°C for 1x24 hours. The dried beet peel was mashed using a dry mill and then sieved using a 100-mesh sieve to produce flour with smaller granules.

Procedure for Chicken Patties With the Addition of Red Beet Peel Flour
The essential ingredients for making patties are that the chicken meat is removed from the fat and the peel is washed clean. The chicken meat is ground using a meat grinder and added with ice cubes and other ingredients, including tapioca flour, egg whites, pepper, onions, garlic, salt, sugar, and mushroom broth. The next step is to add beetroot flour according to the specified treatment, 0%, 1%, 2%, and 3% of the total ingredients.

The dough is then weighed and pressed on a mold to form patties of the same size. With the addition of RBPF, the chicken patties dough is steamed using a baking sheet for 5 minutes. Patties cooked are drained and cooled, then greased and baked over low heat.

Analysis Measurement

Carbohydrate
Carbohydrate analysis with AOAC (2005), using a different method from proximate analysis when $100 - (\% \text{ moisture content} + \% \text{ protein content} + \% \text{ fat content} + \% \text{ ash content})$.

Texture
Texture using a texture analyzer, by pulling or pressing the sample so that a force record is obtained (De Man, 1999).

pH Value
pH value measurement with AOAC (2005), using the immersion method with acid and alkaline solutions which are carried out 3 replication, and the average is taken.

Fiber Content
Fiber content with AOAC (2005) present. Determination of fiber content using the gravimetric method with the fibertherm tool. Drying of filter paper and samples was carried out using an oven and furnace.

Organoleptic Quality
Organoleptic quality using a hedonic method with 5 trained panelists. The assessment uses a score of 1-5, and a score of 1 is the most disliked and score of 5 is the most liked. After that, the data was averaged and the standard deviation was sought and continued with descriptive analysis to describe the results of organoleptic quality.
Scanning Electron Microscopy
Scanning Electron Microscopy with (Adhika et al., 2018) method. The preparation stage for this sample is fixation using formalin, dehydrated, and paraffin embedding. Samples that have been planted in paraffin are then sliced using a microtome with the final thickness of the sample being 3µm, then the incision is placed on the cover glass. The resulting incisions were washed using xylene at 37°C for 4x30 minutes. After that, the sample was washed using 100% ethanol at room temperature for 4x15 minutes. The sample was then left overnight at room temperature to dry. Before observing with SEM, the sample is glued with carbon tape. The sample stage is then coated with layers conductive i.e. gold coating using ions sputtering machine.

Data Analysis
To obtain the mean and standard deviation, the data were analyzed in Microsoft excel. Analysis of variance (ANOVA) was used to analyze the resulting data. A Duncan Multiple Ranges Test (DMRT) will be conducted if there is a difference between the treatments.

RESULTS AND DISCUSSION
Carbohydrate
Analysis results of various carbohydrates stated that adding RBPF to chicken patties had a highly significant effect (P<0.01). The average carbohydrates of chicken patties with the addition of RBPF are presented in Table 2. Based on Table 2, the average carbohydrate content of chicken patties with the addition of RBPF ranged from 15.03 - 17.45%. The highest average carbohydrate was in treatment CP3 (3% addition treatment) at 17.45%, while the lowest was in CP0 (control treatment) at 15.03%.

The higher the addition of beet peels to the chicken patties, the average carbohydrate will increase. RBPF contains high levels of carbohydrates and crude fiber. This carbohydrate content is thought to cause increasing the carbohydrate content in the chicken patties as the percentage of RBPF is added. The addition of RBPF will affect the final product quality of each treatment. Patties with the addition of watermelon rind powder had carbohydrate levels ranging from 17.16% - 19.47%, which increased with the addition of watermelon rind powder which contained carbohydrates of 60.85% (Badr, El-Waseif, and Ghaly, 2018).

The increase in carbohydrate content was inversely proportional to the fat content in the patties with the addition of acetate corn starch with an average value of 22.24 – 27.30% (Osman et al., 2022). The addition of corn silk powder which has a carbohydrate content of 13.23% in beef patties with an added percentage of 3% produces carbohydrates of 4.67% (Castillo et al., 2020).

Table 2. Average Carbohydrates of Chicken patties with the Addition of RBPF

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Carbs (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP0</td>
<td>15.03 ± 0.47</td>
</tr>
<tr>
<td>CP1</td>
<td>15.88 ± 0.15</td>
</tr>
<tr>
<td>CP2</td>
<td>16.49 ± 0.17</td>
</tr>
<tr>
<td>CP3</td>
<td>17.45 ± 0.54</td>
</tr>
</tbody>
</table>

Note: Different notation in the same column mean a highly significant difference (P<0.01)

Texture
Analysis results of texture variance stated that adding RBPF to chicken patties had a very significant effect (P<0.01). The average texture of chicken patties with the addition of RBPF is presented in Table 3. Table 3 states that chicken patties with the addition of RBPF have an average texture value ranging from 11.63 – 14.34 N. The highest average texture is in the CP3 treatment (3% addition treatment) at 14.34, while the lowest texture average is in CP0 (control treatment) at 11.63 N. RBPF has a texture in the form of soft grains and is...
thought to have a very significant effect with the differences in CP0 and CP3 treatments. So, that it can produce a compact texture of chicken patties. The texture value of chicken patties with RBPF increased with the increased percentage of RBPF added.

**Table 3. The Average Texture of Chicken Patties with the Addition of RBPF**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Texture (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP0</td>
<td>11.63 ± 0.27</td>
</tr>
<tr>
<td>CP1</td>
<td>12.54 ± 0.48</td>
</tr>
<tr>
<td>CP2</td>
<td>13.04 ± 0.39</td>
</tr>
<tr>
<td>CP3</td>
<td>14.34 ± 0.23</td>
</tr>
</tbody>
</table>

Note: Different notation in the same column mean a highly significant difference (P<0.01)

The texture of RBPF in the form of grains causes an increase in the texture value of the chicken patties. The texture of the chicken patties has increased, which can be caused by the protein content in the ingredients added. The protein contained in essential ingredients other than meat used in processed meat can increase the textural value and emulsion stability and reduce the cooking loss value of the product (Bakhsh et al., 2021).

The texture and structure of the chicken patties changed due to the addition of RBPF. RBPF can absorb water and fat, affecting the chicken patties textural properties. Layers of protein molecules polymerize and cross-link, then reorient into meat fibers to form textures in processed meat products (Saerens et al., 2021). Fiber and carbohydrates contained in RBPF play a role in improving the texture of chicken patties. Fiber and carbohydrates effectively improve product quality, manufacturing cost efficiency, and the texture of processed meats (Khomola et al., 2021). The interaction between protein and polysaccharides can improve the texture of patties (Samard et al., 2021). The increase in the value of the texture of the patties is directly proportional to the addition of purple sweet potato and carrageenan. The more levels added, the more the value of the texture of the patties (Akram et al., 2022).

**pH Value**

Analysis results of pH variance indicated that adding RBPF to chicken patties had a highly significant effect (P<0.01). The average pH of chicken patties with the addition of RBPF is presented in Table 4. Based on the average values in Table 4, it can be seen that the pH of chicken patties with the addition of RBPF ranged from 5.76 to 6.08. The highest average pH results were in the CP0 treatment (control treatment) of 6.08, and the lowest average pH value was at CP3 of 5.76. The pH value of chicken patties with the addition of RBPF decreased with the increased percentage of RBPF used. The decrease in pH was due to the addition of RBPF.

**Table 4. The Average pH of Chicken Patties With the Addition of RBPF**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP0</td>
<td>6.08 ± 0.07</td>
</tr>
<tr>
<td>CP1</td>
<td>6.00 ± 0.02</td>
</tr>
<tr>
<td>CP2</td>
<td>5.86 ± 0.02</td>
</tr>
<tr>
<td>CP3</td>
<td>5.76 ± 0.09</td>
</tr>
</tbody>
</table>

Note: Different notation in the same column mean a highly significant difference (P<0.01)

The pH value of RBPF used was 4.5 on the research results. In addition, the pH value of chicken patties with the addition of RBPF was influenced by the pH of the raw materials used, namely chicken meat and tapioca flour. Mixing ingredients in the patties formulation results in a change in the hydrogen balance. Patties have a pH that ranges from 6 – 7 (SNI, 1995). Sodium phosphate added to patties increases the pH value, level of tenderness, cooking results, and meat color (Long, Ga’l, and Bun’ka,
The pH value of beef patties with the addition of clove powder ranged from 5.92 – 6.17 (Rumondor and Tinangon, 2021). Textured vegetable protein added to patties increases pH value due to alkalinity (Samard et al., 2021). The pH value of duck meat patties with the addition of sweet potatoes is 6.05 – 6.22 (Sembor et al., 2022). The pH value indicates a change in the structure of the meat processed with restructuring technology, which affects the product. The pH value can also determine the quality of the fresh meat used.

**Fiber Content**

Analysis of the fiber variance indicated that adding RBPF to chicken patties had a very significant effect (P<0.01). The average fiber content of chicken patties with the addition of RBPF is presented in Table 5. The mean value in Table 5 shows that the fiber content of chicken patties with the addition of RBPF ranges from 0.71 - 1.15%. Fiber content was highest in the CP3 treatment at 1.15% and the lowest in the CP0 at 0.71%. The fiber content of low-fat chicken patties with the addition of RBPF and the increase in the flour percentage has increased.

The fiber content increases by treating chicken patties with RBPF. The amount of crude fiber in beet peel flour causes this. The crude fiber content contained in RBPF was 3.57%. Fiber is required for restructuring products because restructuring products lack fiber. Fiber will help form the texture of the product. Functional food Crude fiber is 0.99 - 1.97% in patties with the use of textured vegetable protein with increasing concentrations, fiber content also increases (Samard et al., 2021). The more banana peel powder was added to the broiler nuggets, the more fiber content also increased by 0.51 - 1.62% (Akram et al., 2022).

The crude fiber found in oat flour can increase the fiber content in chicken nuggets, which ranges from 1.20 to 1.81% (Santhi and Kalaikannan, 2014). In addition, adding watermelon rind powder to the patties of 3.6, 9, and 12% increased fiber content ranging from 1.16 to 2.13% (Badr, El-Waseif, and Ghaly, 2018).

### Table 5. The average fiber of chicken patties with the addition of RBPF

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Fiber (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP0</td>
<td>0.71a ± 0.07</td>
</tr>
<tr>
<td>CP1</td>
<td>0.94b ± 0.07</td>
</tr>
<tr>
<td>CP2</td>
<td>1.08c ± 0.04</td>
</tr>
<tr>
<td>CP3</td>
<td>1.15d ± 0.02</td>
</tr>
</tbody>
</table>

Note: Different notation in the same column mean a highly significant difference (P<0.01)

**Organoleptic Quality**

The organoleptic score calculation and analysis showed that adding RBPF to chicken patties with different percentages had a highly significant effect (P<0.01) on the organoleptic quality of color, taste, aroma, texture, and acceptance level. The characteristics of RBPF affect the final product, because organoleptically RBPF has a fragrant aroma and is slightly similar to the aroma of smoked beef and the texture in the form of grains can influence the resulting product. Table 6 below shows the average organoleptic quality of chicken patties with the addition of RBPF. The score results in Table 6 stated that the organoleptic quality of chicken patties with the addition of beetroot flour ranged from 3.10-4.60. Table 6 shows the organoleptic quality of the color of chicken patties with the addition of RBPF ranging between 3.25 – 4.80. The organoleptic quality scores for the aroma of chicken patties with the addition of RBPF based on Table 6 ranged from 3.3 to 4.55. Table 6 shows that the organoleptic quality of the texture of chicken patties with the addition of RBPF at a percentage of 0%, 1%, 2%, and 3% ranged from 3.00 – 4.55. Based on Table 6, the average organoleptic quality score of the acceptance level of chicken patties with the addition of RBPF is between 3.25-4.75. Spider graph can be seen in...
Figure 1, and different colored chicken patties in Figure 2.

This score indicates that the higher the percentage of addition of RBPF to the chicken patties, the color of the patties becomes reddish. Color is the first thing that is assessed when it affects the attractiveness of the panelists to the product. The results of the analysis showed that the highest score was in the CP3 treatment (3% addition treatment) with a score of 4.60 where the panelists liked the color of the chicken patties and the lowest score was in the control treatment of 3.10 which indicated that the color of the patties was liked by the panelists. This is due to the carotenoid content in beetroot flour. Red beet peel contains a substance that can be used as a natural dye in food products, namely the color pigment betacyanin (Silalahi et al., 2022). Betasani in beet peel is 2.4535 mg/100g (Setiawan, Nugroho, and Lestario, 2015). The highest score of organoleptic quality was found in the CP3 treatment (3% additional treatment) with a score of where the patties' taste was balanced between the meat and beet peel flour, while the lowest value was in CP0 (control treatment) which indicated that the taste of chicken meat was more dominant. The taste of patties is influenced by the essential ingredients used. The organoleptic quality score of chicken patties with the addition of beetroot flour with different percentages, namely where the meatballs were favored very liked by the panelists.

### Table 6. Average Organoleptic Quality of Chicken patties with the Addition of RBPF

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Color</th>
<th>Flavor</th>
<th>Aroma</th>
<th>Texture</th>
<th>Acceptance Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP0</td>
<td>3.10 ± 0.82</td>
<td>3.25 ± 0.96</td>
<td>3.30 ± 0.58</td>
<td>3.00 ± 0.82</td>
<td>3.25 ± 0.96</td>
</tr>
<tr>
<td>CP1</td>
<td>3.25 ± 0.96</td>
<td>3.70 ± 0.58</td>
<td>3.65 ± 0.50</td>
<td>3.25 ± 0.96</td>
<td>3.65 ± 0.50</td>
</tr>
<tr>
<td>CP2</td>
<td>3.95 ± 0.96</td>
<td>4.25 ± 0.96</td>
<td>3.95 ± 0.96</td>
<td>3.65 ± 0.96</td>
<td>4.30 ± 0.58</td>
</tr>
<tr>
<td>CP3</td>
<td>4.60 ± 0.82</td>
<td>4.80 ± 0.82</td>
<td>4.55 ± 0.50</td>
<td>4.55 ± 0.50</td>
<td>4.75 ± 0.50</td>
</tr>
</tbody>
</table>

Note: Different notation in the same column mean a highly significant difference (P<0.01)

![Spider Graph of The Average Organoleptic Score of Chicken Patties using RBPF](image)

**Figure 1. Spider Graph of The Average Organoleptic Score**
The use of RBPF on chicken patties gives a distinctive taste and reduces the fishy taste but does not cover the taste of the chicken meat. Beetroots contain geosmin compounds that cause an earthy taste in beetroot flour (Maimunah et al., 2021). The organoleptic quality assessment of chicken patties with the addition of vegetable spikes (Diplazium esculentum) has a relatively high taste rating score (Kumari et al., 2015). The highest score of organoleptic aroma quality was in the CP3 treatment (3% addition treatment) with a score where the aroma of the patties was very liked. In contrast, the lowest score was the control treatment (CP0) score, indicating that the panelists liked the aroma. The score showed that the higher the percentage of beetroot flour added, the patties had a meaty aroma, and a distinctive aroma of beetroot flour where the panelists preferred this aroma. This was because the chicken patties with the addition of beetroot flour had an aroma that attracted the panelists' attention. After all, it was more distinctive and not fishy. Adding beetroot to processed products does not leave a pungent and sharp odor therefore it does not eliminate the original aroma of the raw material (Yunita, Setyaningsih, and Agustina, 2014). The use of beetroot extract in chicken sausage significantly affects the organoleptic quality of the aroma due to the content of geosmin, a compound that forms the aroma of beetroot (Putri et al., 2022). The highest texture score was in the CP3 treatment and the lowest was in the CP0 treatment. Based on this score, it can be seen that the greater the percentage of RBPF added to the chicken patties, the more panelists preferred the texture of the patties. Panelists liked the texture of the patties could have been not mushy, dense, or compact. The organoleptic quality of patties' texture with different woody is moderately soft and hard and hard texture and is not sticky (Sun et al., 2021).

These results indicate that the level of acceptance of chicken patties with the addition of RBPF can be accepted by the panelists with a level of moderately acceptable (score 3) to close to very acceptable (score 5). The level of acceptance is part of the organoleptic quality assessment by considering all components, namely color, texture, aroma, and taste of patties. Chicken patties with the addition of RBPF of 3% had the highest acceptance rate. This is because panelists favor the patties on all assessment components, namely color, texture, aroma, and taste of patties. Chicken patties with the addition of beet peel flour have an attractive color, dense and compact texture, and balanced taste therefore the patties have a high score. The acceptance score, appearance, taste, and soft texture of chicken patties treated with vegetable spikes
Diplazium esculentum) were higher than the control treatment without the addition of vegetable spikes (Kumari et al., 2015).

**Scanning Electron Microscopy**

Microstructure of chicken patties using RBPF with no additional treatment, 1%, 2%, and 3% addition was observed and correlated with physical quality. Microstructural observations using scanning electron microscopy by observing changes in the meat protein matrix, interactions between the ingredients for making patties, and the additions used. The ingredients used for making chicken patties that can be observed are the interaction of chicken meat, egg white, tapioca flour, and beet peel flour. The result of scanning electron microscopy of chicken patties can be seen in Figure 3.

![Scanning Electron Microscopy Images](image-url)

**Figures 3.** (a) Chicken patties without the addition RBPF (CP0); (b) Chicken patties with the addition of 1% RBPF (CP1); (c) Chicken patties with the addition of 2% RBPF (CP2); (d) Chicken patties with the addition of 3% RBPF (CP3). Description: SEM magnification 1000x.

The results of the microstructure of the patties without the addition of RBPF can be seen in Figure (a), where there is an interaction between meat protein and tapioca flour. The microstructure of chicken patties using 1% beet peel can be seen in Figure b. Compared with figure a, chicken patties with RBPF have as much as 1% fewer water cavities—microstructural observations on patties with the addition of 2% RBPF, as shown in Figure c. The results of Figure c show that the resulting texture is more compact than Figure b, supported by the uniformity of the shape of the protein gel produced and the minimum amount of water voids.

The results of microstructure observations of chicken patties with the addition of 3% RBPF can be observed in Figure d. Comparison of observations between images b, c, and d resulted in differences in the matrix resulting from the interaction of meat protein and starch. Tapioca flour which contains starch can interact with proteins to produce a solid form with free water in a small amount and
few air voids. The matrix is noticeably thicker in almost all areas and the interaction of protein and starch has even uniformity. The water voids in microstructural observations were formed due to low water holding capacity and water trapping caused by the interaction of meat protein with starch, producing a gel matrix.

The number of water voids is directly proportional to the water holding capacity produced. The interaction of meat protein and RBPF protein so that the matrix formed produces more complex results. The interaction between meat protein and RBPF protein resulted in a more compact texture. The formation matrix on observing the microstructure was formed due to the gelatinization of the protein (Jiang et al., 2022). (Mathlubaty and Estuti, 2022) explained that the high protein content in additives played a role in the gelatinization process and was influenced by the increased water-holding capacity.

Protein in the flesh and RBPF can affect the water binding capacity, producing a hard texture called gel formation, which can increase the protein gelatinization process (Vatria and Nugroho, 2022). The texture of chicken patties formed with a small amount of water can weaken the interaction between starch and protein, making the resulting texture more rigid (Primadini, Vatria, and Novalina, 2021).

The more additional of RBPF, the more compact the resulting texture, the fewer water voids, and the uniform distribution of water, starch, and protein molecules. The structure of the resulting microstructural observations is influenced by the distribution of particles and the quality of the physical parameters of water holding capacity and texture (Tabak, Abadi, and Serdaroglu, 2019).

CONCLUSION

The addition of RBPF with the best treatment was 3%. Based on the physicochemical quality, organoleptic quality, and microstructure, those addition has excellent nutritional content and RBPF which can be used to improve the texture of processed food products.

REFERENCES


