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Effect of Drying and Size Reduction Techniques on the Characteristic of Instant Seasoning for Shredded Fish

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ABSTRACT

Instant seasoning for spiced shredded fish is practical and serves to expedite the process of producing shredded fish products. Instant seasoning has a potential to be developed and needs to be studied because it has not been found in the nearest supermarket. The objective of this study is to analyze and evaluate the quality of instant seasonings produced using various drying and size reduction techniques. The research was performed according to Completely Randomized Block Design, comprising two factors (i.e. drying techniques and size reduction techniques) and three replicates. Data was analyzed using the LSD (Least Significant Difference) and de Garmo tests to determine the most effective treatment. Seasoning quality was based on sensory attributes, chemical parameters, and microbiological parameters. The findings indicated that the application of drying and size reduction techniques had a discernible impact on the quality of instant seasoning for spiced shredded fish. The P3A1 (drying using food dehydrator and size reduction using chopper) treatment was determined to be optimal with 5.27% moisture content of, 8.57% fiber content, 42.88% free radical inhibition activity, 2.42 log CFU/ml total microbes, and 4.16 of score for overall acceptance.

1. INTRODUCTION

Indonesia is popular for its rich spice wealth. Statistical data in 2024, Indonesia exported spices totaling 24.39 million kg with an export value of 118 million US dollars (BPS Indonesia, 2024). In 2023 Lampung Province exported up to 174,716.90 tons of spices (BPS Provinsi Lampung, 2024). Spices are used to create flavors in dishes, preserve food, and natural food colorings (Hajriansyah, 2023; Sartika *et al*., 2023). In the modern times, people prefer everything that is fast, instant, and practical. One of the products of choice and widely used in everyday life is instant seasoning.

Instant seasoning is a combination of various types spices that go through processing and certain recipes into one ready-to-use seasoning formulation. Instant seasoning has a function to facilitate work in the kitchen without having to go through a long process such as sorting spices, washing, crushing to cooking. Seasoning has a relatively short shelf life, so instant seasoning is an option to extend the shelf life and as an effort to overcome the availability of some spices that are rare in certain seasons (Mareta *et al*., 2019; Aisyah *et al*., 2020). All food products require seasoning in their processing, one of which is shredded.

Abon is a popular product made from shredded meat or fish and added seasonings. Abon is made through a process of boiling, frying, and oil separation with the aim of producing a soft texture, rich flavor, and a long shelf life (Huthaimah *et al*., 2017). Making shredded meat requires a variety of spices and relatively long processing stages, so instant seasoning is the right solution to facilitate the making of shredded meat or fish and can be done independently. This instant seasoning for spiced shredded fish is a potential product to be developed because until now it has not been found

in supermarkets that sell instant seasoning. The process of making this seasoning consists of sorting spices, washing, drying, and packaging.

Drying is the process of removing water from materials thermally with the help of heat so that the water content is reduced, reducing the volume of the product, and extending the shelf life of the product (Handoyo & Pranoto, 2020; Sanjaya *et al*., 2023). Some factors that affect the drying process are internal factors (surface area, material size, and physical condition of the sample) and external factors (temperature, time, humidity, and air pressure) (Handoyo & Pranoto, 2020). Size reduction is a method used to expand the surface of the material which aims to make the drying process run effectively, increase the even drying of the material, and ease of further processing (Salahuddin *et al*., 2022). In maintaining quality, the important things to consider are drying and size reduction techniques.

This research was conducted to evaluate and analyze the quality of instant seasoning produced by different drying and size reduction techniques. The drying techniques used in this study included conventional drying, oven, and food dehydrator. Meanwhile, the size reduction techniques chosen were slicing, chopper, and chopper press. These drying and size reduction techniques have not yet been developed in the manufacture of shredded instant seasoning.

2. RESEARCH METHODS

2.1. Materials and Tools

The main ingredients included turmeric, pepper, galangal, lemongrass, coriander, ginger, garlic, shallots, curly red chili, orange leaves, bay leaves, and lime. Other materials are aluminum foil packaging, 2,2-diphenyl-1-picrylhydrazyl (DPPH), ethanol 96%, H_2SO_4, NaOH, distilled water, buffered peptone water (BPW), and plate count agar (PCA). The tools used were knife, cutting board, digital scale, chopper, grinder, oven, food dehydrator, 60 mesh sieve, baking sheet, filter paper, desiccator, incubator, laminar air flow, and glassware.

2.2. Research Design

This research was arranged in Completely Randomized Block Design consisting of 2 factors and 3 replications. The first factor was drying techniques including P1 (conventional drying or sun drying), P2 (oven drying), and P3 (food dehydrator). The second factor was size reduction techniques (A1 = slicing, A2 = chopping, and A3 = chopping and pressing). The data obtained were analyzed using analysis of variance (ANOVA) to obtain estimates of the variance of errors and determine the effect of treatment. Next, the data were further tested with LSD (Least Significant Difference) at the 5% level. The best treatment was determined by de Garmo Weighted Effectiveness test (de Garmo *et al*., 1984).

2.3. Instant Seasoning Preparation

The composition of the spice formulation used in making this instant spice shredded seasoning is turmeric 3.5 g; coriander 2.25 g; pepper 1.25 g; lemongrass 6.5 g; ginger 3 g; galangal 2.5 g; garlic 17.5 g; shallots 32.5 g; bay leaves 1.5 g; curly red chili 50 g; lime 1.5 g; lime leaves 1.5 g; and salt 15 g (Sartika *et al*., 2024), with modifications. The spices to be used were first cleaned of skin and dirt, then washed and weighed according to the specified formulation. Next, the spices were reduced in size by applying slicing, chopper, and chopper press techniques. After size reduction, the spices were dried using conventional drying method (sun drying) at ±30°C for 2 days (Salahuddin *et al*., 2022; Wardhani *et al*., 2023), dryer oven (70°C for 7 hours) (Husna *et al*., 2017; Murti, 2017), with modifications, and food dehydrator (70 °C for 7 h) (Nairfana & Larate, 2023), with temperature and time modifications. After drying, the spice was pulverized using a grinder for 5 min, then screening using a 60 mesh stainless steel sieve.

2.4. Sensory Analysis

Sensory evaluation of instant seasoning of shredded spices using Scoring Test and Hedonic Test conducted on 20 trained panelists. The trained panelists were selected based on the selection of good sensory sensitivities and trained internally (Sari & Nurjanah, 2023). The scoring test focused on color and aroma parameters, while the hedonic test on texture and overall acceptance parameters. Samples were coded and presented randomly to panelists, then panelists gave ratings on a prepared questionnaire sheet including color scoring test as detailed in Table 1.

Table 1. Scoring criteria for sensory testing

Score	Color	Aroma	Texture	Overall Acceptance
1	not yellow	not typical of spices	dislike	dislike
2	yellow	slightly typical of spices	little like	little like
3	bright orange yellow	spice distinctive	like	like
4	bright orange	very spice distinctive	very like	very like
5	intense orange	very spice distinctive	very like	very like

2.5. Chemical Parameter Analysis

The chemical quality characteristics of shredded spice instant seasoning refer to the SNI 01-3709-1995 standard on Spice Powder (BSN, 1995) for the moisture content parameter. Moisture content analysis was determined by gravimetric method (AOAC, 2019), fiber content is determined based on SNI 01-2891-1992 (BSN, 1992), and the activity of free radical inhibition (DPPH) was determined in (Shimamura *et al.*, 2014; Ali *et al.*, 2020).

2.3.4. Microbiology Analysis

The microbiological quality of instant seasoning for shredded fish was carried out by testing total microbes using the Total Plate Count (TPC) method referring to SNI 01-2891-1992 (BSN, 1992). 25 gram powder sample was dissolved in 225 ml of BPW (Buffered peptone water) diluent. A suspension of 1 ml was transferred to BPW diluents 10^{-1} to 10^{-6}. Next, 1 ml of each diluent was pipetted into a sterile dish containing Plate Count Agar (PCA). After that, the Petri dish was homogenized by shaking, then incubated in an incubator at 37°C for 24-48 hours. Then the number of colonies was counted with the equation:

$$Colony = Colony\ count \times \frac{1}{Dilution\ factor} \quad (1)$$

3. RESULTS AND DISCUSSION

3.1. Sensory Characteristics

Analysis of variance showed that the interaction factor of drying technique and size reduction had a significant effect on the color of the spices produced (F_{count} 3.746 > $F_{(0.05)}$ 3.007). Figure 2 shows that the highest color score in treatment P3A3 (dehydrator and chopping + pressing) is 4.47 (bright orange) and the lowest score is 3.21 (bright orange yellow) in P1A1 (conventional drying and chopping). The P3A3 treatment of all ingredients is crushed and removed the water content (press) causing the surface area of the material to increase, so that when drying the remaining water contained in the material will evaporate quickly and evenly resulting in the color of the seasoning becoming bright orange. This is

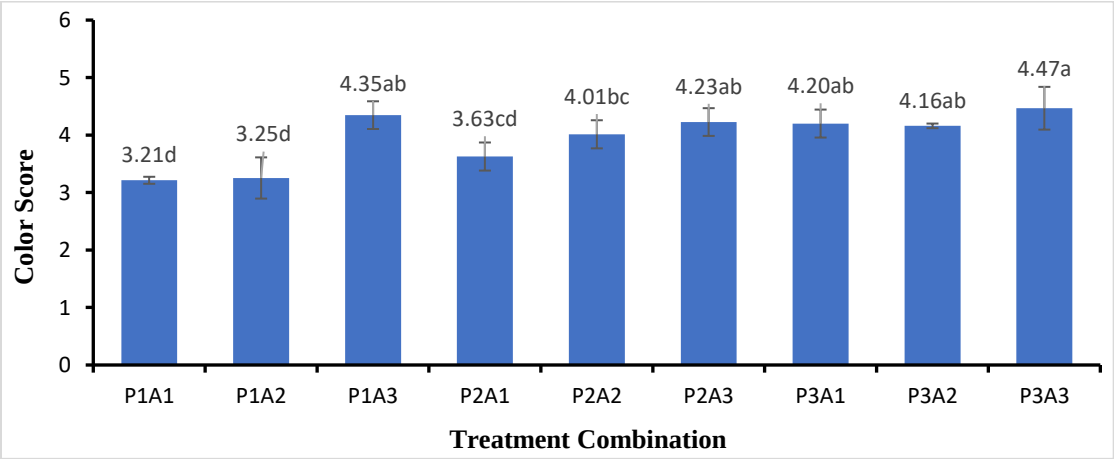

Figure 1. Effect of treatment combinations on the panelists' preference about color of the seasonings [Different letters following mean values indicate significant different based on LSD test at 5%]

in accordance to Ilmi *et al* (2022) that smaller materials result in higher surface, making it easier for heat flow to enter the cavities of the material so that the water content in the material evaporates more easily and dries quickly. Food dehydrator principle operates with a heating element, on the inside there is a fan that serves to circulate hot air on the dried material. Then the hot air will be released through the air vent, while the tray inside the dryer serves to collect water that comes out or drips from the material (Rosadi *et al*., 2023). The larger surface area and effective drying (food dehydrator) causes color oxidation, resulting in a more even seasoning color of bright orange.

Other factors that affect the color of instant spices are the composition and natural pigments of the spices used. Turmeric contains about 1–6% curcuminoid compounds that provide yellow color pigments (Nelson *et al*., 2017; Pardede, 2021). Likewise, curly red chilies also contain carotenoid compounds that provide yellow and red pigments. Carotenoids found in red chilies include capsantin (30–70%), beta-carotene, and cryptocapsin (Suliasih *et al*., 2018).

In the aroma parameter, the results of ANOVA analysis of variance showed that the interaction of drying techniques and size reduction had a significant effect (F_{count} 6.897 > $F_{(0.05)}$ 3.007). LSD further test at 5% level showed that the highest aroma score was found in P3A2 treatment (food dehydrator and chopping) with a score of 4.25 (very typical of spices). While the lowest aroma score was in the P2A2 treatment (oven and chopping) with an average of 3.56 (typical of spices), as shown in detail in Figure 2.

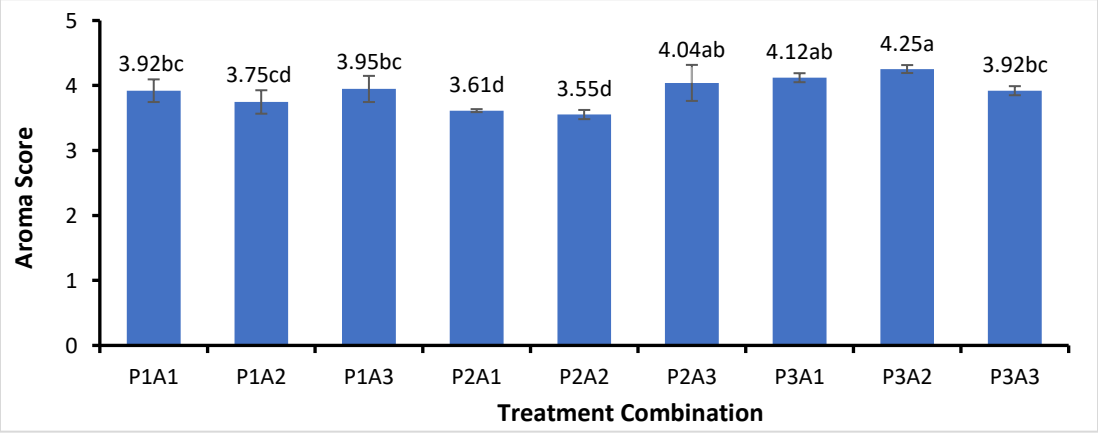

Figure 2. Effect of treatment combinations on the panelists' preference about aroma of the seasonings [Different letters following mean values indicate significant different based on LSD test at 5%]

In the interaction of food dehydrator treatment and sliced seasoning materials, the size of the seasoning material is reduced using a knife so that the surface area becomes larger, when dried using a food dehydrator, hot air will be flowed by a fan and released through air circulation slowly so that the volatile compound components of spices such as allicin, diallyl disulfide, capsaicin, zingerone, citral, and others are not damaged and maintained with a very distinctive aroma typical of spices. While in the oven and sliced treatment, the sample that has been reduced in size will be placed on the oven tray and supplied with heat delivered by the heating element so that the water will evaporate quickly and cause the volatile compounds to evaporate, decrease, and experience damage as indicated by the typical aroma criteria of spices. This is in line with (Pranoto *et al*., 2019), that size reduction and drying activity affect the organoleptic properties of neem (*Azadirachta indica*) leaf powder samples soaked in olive oil, the smaller the size, the stronger the aroma.

The aroma of the shredded spice instant seasoning produced comes from the aromatic compounds of the spices used. Galangal contains sesquiterpene and E-methyl cinnamate which produce a distinctive aroma and flavor. Lemongrass contains citral, geraniol, and geranial compounds that have a distinctive lemon-like aroma; while onions contain organosulfur compounds such as alliin which are highly volatile and unstable when exposed to heating (Alamsyah *et al*., 2024; Pardede, 2021; Sartika *et al*., 2023; Suliasih *et al*., 2018). Instant seasoning shredded spices with treatment P3A2 (food dehydrator and chopping) has a higher aroma score than P3A2 (oven and chopping), this is due to differences in the heat flow system of the drying equipment used.

Next, the texture sensory parameters showed that drying technique and size reduction had a significant effect on texture, while the interaction between the two had no effect (F_{count} 0,173 < $F_{(0,05)}$ 3,007). Figure 3a shows that the treatment most favored by panelists is P3 (food dehydrator drying) with the highest score of 4.03 (very like), while the treatment with the lowest score P1 (conventional drying) with an average score of 3.40 (like). The difference in texture produced is influenced by the working technique of the drying equipment used, namely conventional drying is done by placing the spices on a tray and dried using sunlight causing the spices to have an uneven level of dryness, resulting in a slightly rough and uneven texture. Drying using a food dehydrator is equipped with good temperature and humidity control, so that the spices dry evenly and produce a smoother texture.

Figure 3b shows that size reduction technique A1 (slicing) has the highest score of 4.00 (very like), while the lowest score A2 (chopping) is 3.62 (like). The A1 treatment was favored because the instant spice shredded spices had a smooth and even texture, while the A2 treatment had a slightly rough texture that was not favored by many panelists. The A1 treatment was carried out using the chopper size reduction technique, which is a crushing tool that has a fast-moving blade, so that the crushing process is more intensive. While the slicing size reduction technique is done using a knife manually with varying levels of slice thickness, resulting in a seasoning texture that is not smooth and slightly rough. According to Rizkiana *et al* (2024) the number of pores formed due to the drying process and the surface area function to release water vapor so that the material becomes dry and smooth.

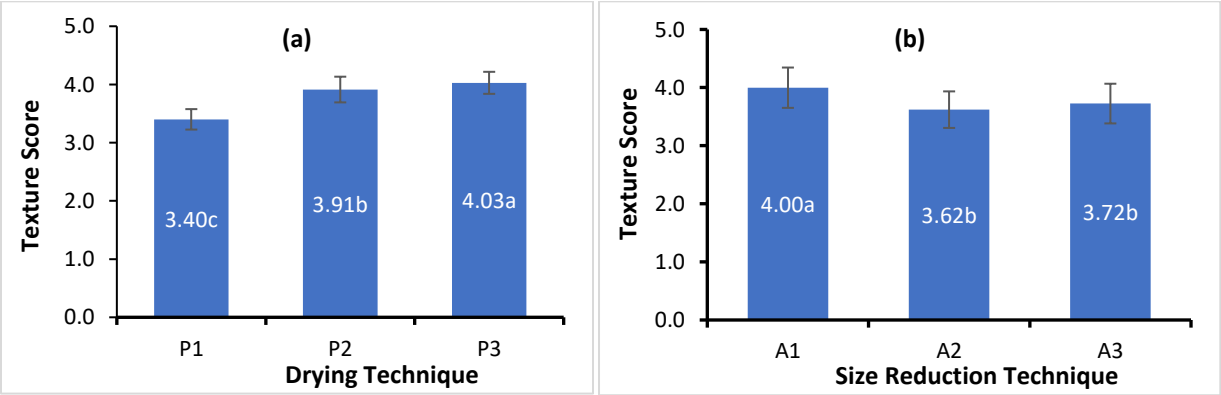

Figure 3. Score of panelists' preference on the texture of seasonings due to treatment factor: (a) Drying techniques, and (b) Size reduction techniques. [Different letters following mean values indicate significant different based on LSD test at 5%]

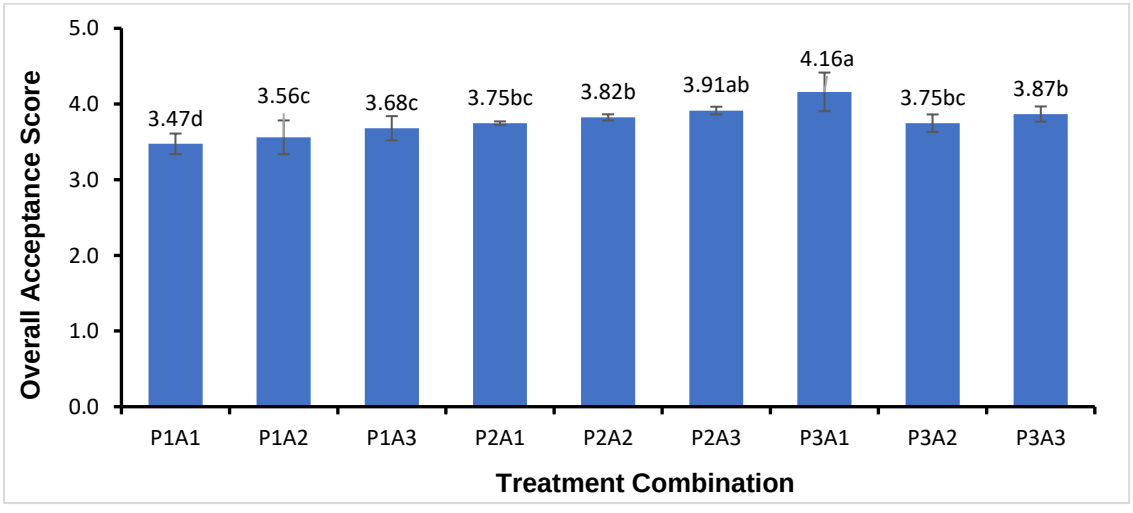

Figure 4. Effect of treatment combinations on the overall acceptance score for the seasonings [Different letters following mean values indicate significant different based on LSD test at 5%]

The sensory parameters of overall acceptance showed that the interaction of drying technique and size reduction factors (F_{count} 3.510 > $F_{(0.05)}$ 3.007) significant effect on the overall acceptance of instant seasoning of shredded spices. Figure 4 shows that the highest value of overall acceptance was obtained in the P3A1 treatment interaction score of 4.16 (very like), while the lowest was in P1A1 score of 3.47 (like).

The overall acceptance parameter is a sensory parameter used in the hedonic test which aims to measure the level of panelist preference for the overall sensory parameters of the product (Husnun *et al*., 2025). Panelists' assessment of the overall acceptance score showed that the instant seasoning of shredded spices treatment P3A1 (food dehydrator and slicing) was most favored by panelists as indicated by the highest hedonic score. This treatment has the criteria of bright orange color, very distinctive aroma of spices, and smooth texture (very like). While the least preferred product by panelists is indicated by the acquisition of the lowest average score, namely in the P1A1 treatment (conventional drying and slicing) which has bright orange yellow color criteria, a distinctive aroma of spices, and a slightly fibrous and uneven texture (like).

3.2. Chemical Characteristics

3.2.1. Moisture Contents

The results of the analysis of variance (ANOVA) showed that the drying technique (F_{count} 233.755 > $F_{(0.05)}$ 3.634) and size reduction (F_{count} 25,330 > $F_{(0,05)}$ 3,634) significant effect, but the interaction between the two (F_{count} 0.853 < $F_{(0.05)}$ 3.007) was not significant on the moisture content of the spices. The LSD Test results of drying factors with the highest value were found in P1 (conventional drying) with an average of 8.93%, while the lowest water content was in the P3 treatment (food dehydrator drying) with a value of 5.23% (Figure 5a). Conventional drying with sunlight as a heat source that takes place slowly due to unstable temperature (±30 °C) for 2 days until the spice sample is dry does not significantly affect the moisture content parameter. The LSD Test results of drying factors with the highest value were found in P1 (conventional drying) with an average of 8.93%, while the lowest water content was in P3 (food dehydrator drying) treatment with a value of 5.23%. Conventional drying with sunlight as a heat source is slow because the temperature is unstable (±30 °C) for 2 days until the spice sample is dried (Salahuddin *et al*., 2022; Wardhani *et al*., 2023). Meanwhile, oven treatment uses a device with temperature and time control, making it more stable. However, the heat process in the oven is unidirectional, while in the food dehydrator the hot air flow from all sides towards the dried material so that it is more evenly distributed and produces lower water content. According to (Sutamihardja *et al*., 2018) that the higher the drying temperature, the lower the moisture content of the material.

Figure 5b shows that the highest water content in the size reduction factor is found in the A2 treatment (chopping) with an average of 7.64%; while the smallest water content is in the A3 treatment (chopping and pressing) with an average of 6.43%. The smaller the size, the smaller the moisture content produced due to the larger surface area that will facilitate the diffusion process so that evaporation becomes faster (Wardhani *et al*., 2023). Arbaiah (2019) explains that slicing with thicker slices resulted in higher moisture content due to the slower evaporation process.

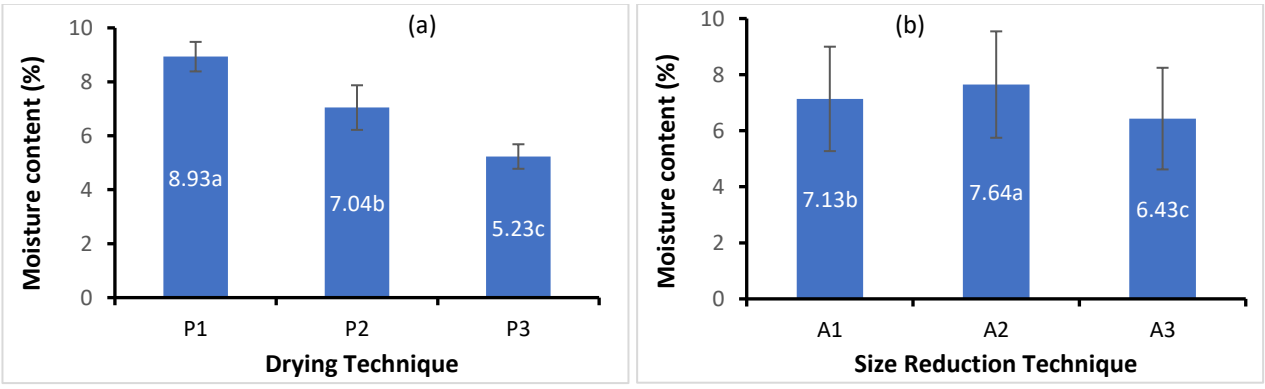

Figure 5. Score of panelists' preference on the moisture content of the seasonings due to treatment factor: (a) Drying techniques, and (b) Size reduction techniques. [Different letters following mean values indicate significant different based on LSD test at 5%]

3.2.2. Fiber Content

The results of the analysis of variance showed that drying techniques and size reduction had a significant effect on crude fiber content, but the interaction between the two had no effect (F_{count} 125.357 > $F_{(0.05)}$ 3.634). LSD Test in Figure 7 shows that the drying factor P3 (food dehydrator drying) has the highest fiber content of about 10.33%; while the lowest fiber content is in the P2 (oven drying) treatment with a value of 8.00%. Both drying treatments were carried out at a temperature of 70°C, but there are differences in the heat flow system, namely in P2 (oven drying) in one direction while P3 (food dehydrator drying) heat flow from all sides towards the material (air circulation), so that the crude fiber content of P2 is lower. According to (Agustin *et al*., 2020) the higher processing temperature causes the crude fiber content to be lower, this is due to fiber components such as cellulose, hemicellulose, and pectin being degraded during the processing process. Based on the size reduction factor, treatment A3 (chopping and pressing) has the highest score of 11.90%; while the lowest is treatment A1 (slicing) 7.75%. This is because the size reduction process carried out using a chopper and pressurized using a press can reduce the water content of the material, thereby increasing the fiber concentration. Fiber content correlates with the water content of the resulting seasoning, the higher the fiber content along with the lower the water content. In line with Soedirga *et al* (2018) and Utama *et al* (2022), that a decrease in moisture content in the material is followed by an increase in crude fiber.

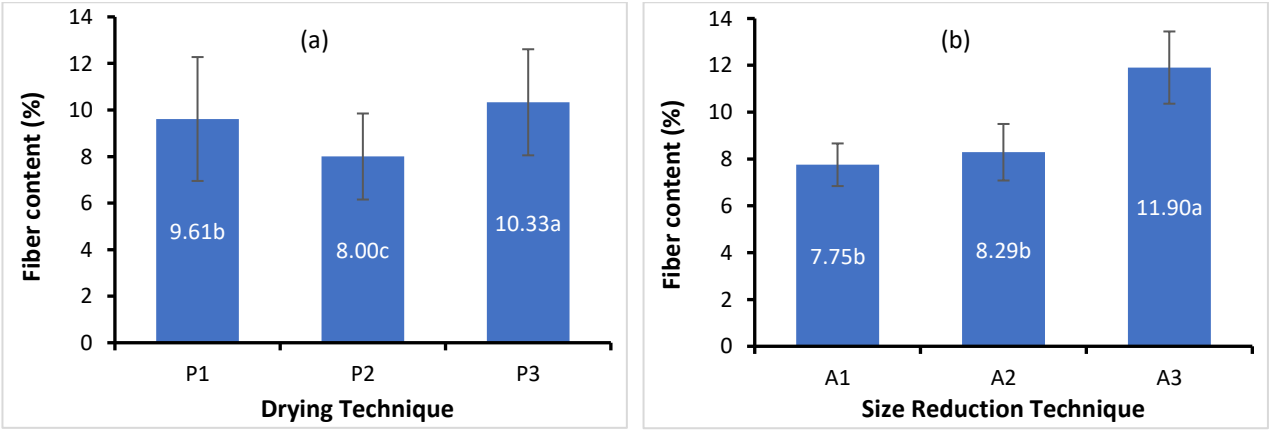

Figure 6. Score of panelists' preference on the fiber content of seasoning due to treatment factor: (a) Drying techniques, and (b) Size reduction techniques. [Different letters following mean values indicate significant different based on LSD test at 5%]

3.2.3. Free Radical Inhibitory Activity

The analysis of variance showed that the factors of drying technique and size reduction had a significant effect on the free radical inhibitory activity of instant seasoning of shredded spices, but the interaction between the two had no significant effect (F_{count} 0.233 < $F_{(0.05)}$ 3.007). The results of LSD test on drying factor (Figure 7) showed that the highest free radical inhibitory activity was found in treatment P1 (conventional drying) with a score of 41.63%, while the lowest score was found in P2 (oven drying) with a score of 37.58%. The decrease in free radical inhibitory activity occurred along with the increase in temperature and drying time. Conventional drying takes a long time because it is dried under the sun and depends on the weather. Drying lemon myrtle leaves using sunlight takes 2 days (Saifullah *et al*., 2019).

Figure 8 shows that treatment A2 (slicing) has the highest free radical inhibitory activity with a score of 48.12%; while treatment A3 (chopper and press) has the smallest score of 24.04%. The slicing technique produces thin pieces of spices and has a smaller surface area, so the degradation of bioactive component compounds is smaller. Whereas in A1 (slicing) using a chopper tool that causes a larger surface area, also in A3 (chopping and pressing) pressing is carried out which causes greater loss of water content and water-soluble compound components are also released such as phenolic compounds, flavonoids, and vitamin C so that the lowest free radical inhibitory activity. Rahmawati *et al*. (2020) explains that as the concentration of egg white increases, the surface area becomes larger, causing the bioactive components of the red rose extract powder drink to decrease and evaporate with the water vapor.

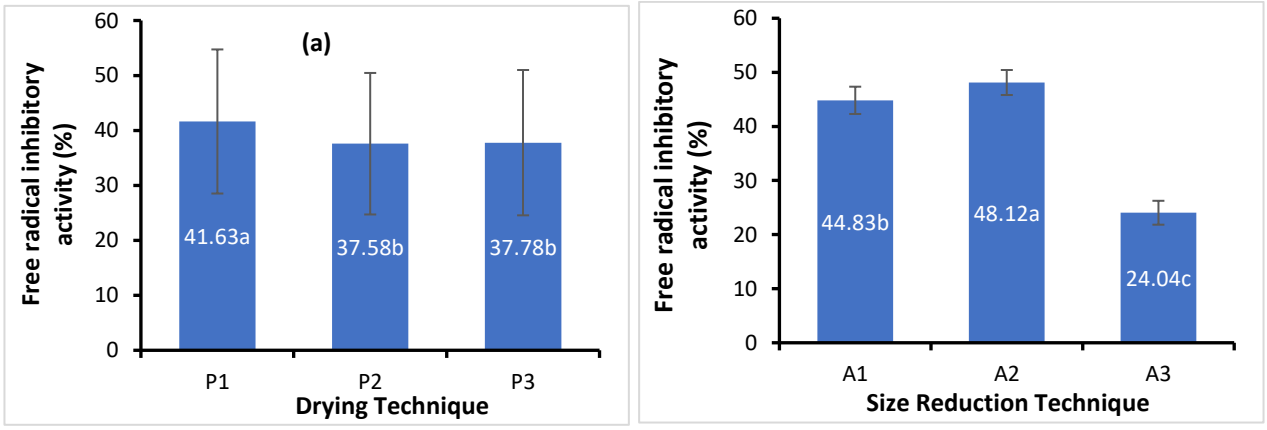

Figure 7. Score of panelists' preference on the free radical inhibitory activity of seasoning due to treatment factor: (a) Drying techniques, and (b) Size reduction techniques. [Different letters following mean values indicate significant different based on LSD test at 5%]

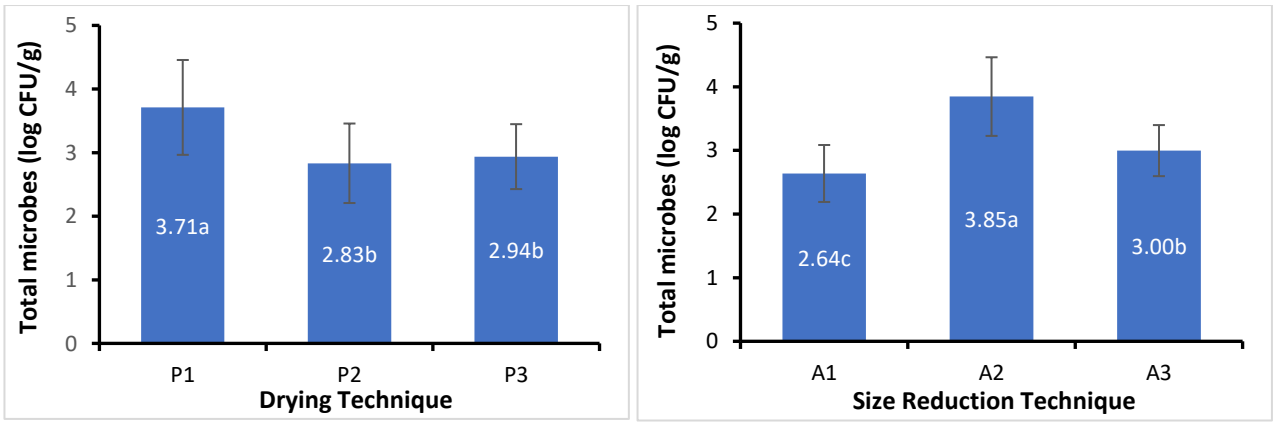

Figure 8. Score of panelists' preference on the total microbes of seasoning due to treatment factor: (a) Drying techniques, and (b) Size reduction techniques. [Different letters following mean values indicate significant different based on LSD test at 5%]

3.3. Microbiological Characteristics

The results of analysis of variance showed that drying and shrinking techniques had an effect on the total microbial count of instant seasoning of shredded spices. Total microbes based on LSD TEST results ranged from 2.64-3.85 Log CFU/g. Based on the drying technique factor (Figure 8), the highest total microbes were found in treatment P1 (conventional drying) with an average of 3.71 Log CFU/g; while the smallest total microbes were in treatment P2 (oven drying) 2.83 Log CFU/g which was not significantly different from P3 (food dehydrator drying) with a score of 2.94 Log CFU/g. According to (Priyanto *et al*., 2021) the higher the heating temperature of collagen milk, the lower the total microbial count. Total microbial count is correlated with moisture content, high moisture content may lead to high microbial growth (Majumdar *et al*., 2023). Based on the percentage of moisture content of shredded spice instant seasoning, treatment P1 (conventional drying) and size reduction factor A2 (chopping) had the highest moisture content of 8.93% and 7.64% respectively; both had the highest total microbial values of 3.71 log CFU/g and 3.85 log CFU/g.

Figure 8b shows that size reduction technique were significantly different, with total microbes in the order of A2 (chopping) 3.85 log CFU/g; A3 (chopping and pressing) 3.00 log CFU/g; and A1 (slicing) with a score of 2.64 log CFU/g. This indicates that the size reduction associated with the surface area of the ingredients, tools, and length of contact with air affect the occurrence of contamination. In the A2 treatment (chopping) is done manually and the air contact in the open space is longer so that microbial growth is greater. In addition, the surface area is smaller and

inhomogeneous causing an uneven slicing process which causes microbial opportunities to grow and develop faster. Meanwhile, treatment A1 (slicing) has the smallest total microbial value due to a faster crushing process, in a closed room (chopper tool), and a larger surface area so that the spice sample dries quickly and prevents microbial growth. According to (Kusumaningrum *et al*., 2015) slicing produces a non-uniform size, thick slices need long time to dry that easier to be contaminated.

3.4. Best Treatment

Determination of the best treatment for instant seasoning of shredded spices refers to the weighting effectiveness test (de Garmo). The best treatment was selected based on the highest weight gain. Based on the de Garmo test results, it shows that the best treatment is P3A1 (food dehydrator and slicing) with the highest total weight gain of 0.832. The detailed recapitulation results can be seen in Table 1.

Table 1. Recapitulation of the best treatment P3A1 (drying using food dehydrator and size reduction using chopper)

Test parameter	Test result	Description
Moisture content	5.27%	max 12% (SNI 01-3709-1995)
Fiber content	8.57%	-
Free radical inhibitory activity	42.88%	-
Total microbes	2.42 log CFU/g	max 10^6 (SNI 01-3709-1995)
Sensory: Color	4.20	Bright orange
Sensory: Aroma	4.12	Very typical of spices
Sensory: Texture	4.28	Very like
Sensory: Overall acceptance	4.16	Very like

4. CONCLUSION

It was concluded that the drying technique affected the characteristics of moisture content, fiber content, free radical inhibitory activity, total microbes, color, aroma, texture, and overall acceptance; the size reduction technique factor affected moisture content, fiber content, free radical inhibitory activity, total microbes, color, and texture; while the interaction of the two factors affected color, aroma, and overall acceptance. The right treatment in making instant seasoning of shredded spices is to use food dehydrator drying and slicing size reduction (P3A1). The results of this treatment combination consisted of moisture content of 5.27%; ash content of 31.52%; fiber content of 8.57%; free radical inhibitory activity of 42.88%; total microbes of 2.42 log CFU/ml; color sensory score of 4.20 (bright orange); aroma of 4.12 (very typical of spices); texture of 4.28 (very like); and overall acceptance of 4.16 (very like).

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