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Producing Soursop Chips Using Vacuum Frying Fryer with Modification of Temperature and Pressure

Pembuatan Keripik Sirsak Menggunakan Penggorengan Vacuum Frying Dengan Modifikasi Suhu dan Tekanan

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ABSTRAK

Sirsak merupakan buah yang cukup bernilai ekonomis, namun merupakan buah yang mudah busuk dan mudah rusak sehingga dapat mengakibatkan turunnya nilai jual buah sirsak. Karena buah sirsak mudah rusak, pengelolaan pascapanen yang buruk dapat mengakibatkan kehilangan hasil yang signifikan. Buah sirsak yang matang memiliki umur simpan hanya 2-3 hari. Karena umur simpan buah sirsak relatif terbatas, diperlukan diversifikasi produk dari buah sirsak, seperti mengolaj sirsak menjadi keripik. Pada umumnya penggorengan standar tidak bisa digunakan untuk membuat keripik sirsak. Namun, seiring dengan peningkatan teknologi, penggorengan vakum memungkinkan produksi keripik sirsak. Penelitian ini menggunakan rancangan acak lengkap faktorial dengan dua variabel yaitu suhu penggorengan faktor I (75, 80, dan 85 °C) dan tekanan penggorengan faktor II (-65, -68, dan -71 cmHg). Data yang diperoleh dianalisis, dilanjutkan dengan uji organoleptik dan pembobotan parameter. Parameter yang dianalisa adalah kadar air, susut bobot, lama waktu penggorengan, sedangkan untuk uji organoleptik dilakukan terhadap warna, rasa, kerenyahan dan aroma. Hasil penelitian menunjukkan bahwa pengaruh suhu dan tekanan penggorengan vakum terhadap mutu keripik sirsak berpengaruh sangat nyata terhadap kadar air, susut bobot, lama waktu penggorengan, dan uji organoleptik terhadap warna, kerenyahan, rasa dan aroma. Nilai Kadar air berkisar 4,33 – 7,44% susut bobot berkisar antara 69,33 – 75,16% dan lama waktu penggorengan berkisar antara 39 – 49 menit.

Kata kunci: Sirsak, Penggorengan vakum, Suhu penggorengan, Tekanan penggorengan.

ABSTRACT

*Soursop is a fruit that is quite economically valuable, but soursop is included in perishable fruit, where the fruit is easily damaged which can lead to a decrease in its selling value of soursop fruit. The perishable nature of soursop fruit can result in high yield losses if not properly handled post-harvest. Ripe soursop fruit can only last for 2-3 days. The short shelf life of soursop causes the need for product diversification from soursop fruit. Generally, soursop chips cannot be made using conventional frying. However, as technology advances using vacuum frying, processing soursop into chips makes it possible. The study used a factorial completely randomized design consisting of two factors, namely factor I frying temperature consisting of 75, 80, and 85 and factor II frying pressure consisting of 65, 68, and -71 cmHg. The data obtained were analyzed, followed by organoleptic tests and parameter weighting. Parameters analyzed were moisture content, weight loss, and length of frying time, while organoleptic tests were carried out on color, taste, crispness, and aroma. frying time, and organoleptic test for color, **crispness**, taste, and aroma. The water content value ranged from 4.33 to 7.44%, the weight loss ranged from 69.33 to 75.16%, and the frying time ranged from 39 to 49 minutes.*

Keywords: *Soursop, Vacuum frying, Frying temperature, Frying pressure.*

INTRODUCTION

Soursop is a tropical fruit native to Indonesia. In Lampung, a total of 3,293 tons of soursop were effectively produced (BPS, 2016). Soursop is a fruit that is quite economically valuable; however, soursop is a perishable fruit, which means that the fruit is easily damaged, resulting in a decline in the selling value of soursop fruit (Septia et al., 2016). Because soursop fruit is perishable, improper postharvest management can result in significant yield loss.

Soursop has a green skin, white flesh, a soft texture, a mildly sour flavor, and a unique aroma. Soursop is high in fiber, vitamins, and nutrients. According to Septia et al., (2016), the high water content of soursop fruit causes it to spoil quickly once ripe. Ripe soursop fruit has a shelf life of only 2-3 days. Because of the relatively limited shelf life of soursop, product diversification from soursop fruit is required.

The juice, jam, and lunkhead are the most common goods made from soursop fruit. Because of the relatively high soursop production and relatively short shelf life, there is a need to diversify products made from soursop fruit in order to increase the fruit's selling value and prolong its shelf life. Soursop fruit diversity has resulted in the creation of lunkhead. This expansion prompted the manufacture of soursop chips. Fried products have a greater appeal to consumers where the process is quick and easy, according to Hilapad et al. (2020). In general, making soursop chips cannot be done in a standard frying pan. However, as technology improves, vacuum frying allows for the production of soursop chips.

Vacuum Frying is a special machine designed to make it easier to produce fruit and vegetable chips. In the operation of vacuum frying there are several things that must be considered, such as the temperature and vacuum pressure used when frying. By using low temperatures damage to color, aroma, taste and nutrients can be avoided (Diamante et al., 2015). As in the research conducted by Belkova et al. (2018), potato chips are directly affected by the temperature used, this will affect the level of crispness, taste and color. In a study conducted by Arum (2012), compared to conventional frying pans that have high temperatures, the results of vacuum frying at 80-90 ℃ will have better color, aroma and taste. According to Ayustaningwarno et al., (2020), the use of low temperatures will help maintain the taste, color and aroma of the product to be produced. According to Moreira (2014), the difference in vacuum frying temperature will have an effect on organoleptic values such as color, taste and overall acceptance. Not only temperature will affect the chips produced, there is also pressure. According to Jamaluddin (2011), the boiling point of water contained in food can be affected by pressure. The pressure in making chips will affect the level of crispness. Higher frying temperatures produce better crispness compared to lower frying temperatures (Maity et al., 2014). From the background above, it is necessary to conduct research to determine the effect of using temperature and pressure on the quality of soursop chips.

METHODS

Place and time of research

This research was conducted at the Postharvest and Bioprocess Engineering Laboratory, Faculty of Agriculture, Department of Agricultural Engineering and Integrated Laboratory from December 2021 to January 2022.

Tools and materials

Local varieties of soursop fruit harvested from farmers' gardens in Pesawaran Regency and cooking oil. The tools used are vacuum frying, spinner, knife, scales, oven and ziplock plastic.

Research design

Factorial Completely Randomized Design. This research was conducted with 2 factor experimental method. The first factor was frying temperature (75 ℃, 80 ℃ and 85 ℃) and the second factor was frying pressure (-65 cmHg, -68 cmHg and -71 cmHg), with 3 replications to obtain 27 experimental units. The temperature level used was obtained from the results of preliminary research by trial and error. After the combination of temperature and pressure is produced, in this main study the order of frying is determined as shown in Table 1, with the symbol temperature (T) covering T1 of 75℃, T2 of 80℃, T3 of 85℃ and pressure (P) of P1 of -65 cmHg, P2 is -68 cmHg and P3 is -71 cmHg.

Table 1. Trial frying tretament

Group 1	Group 2	Group 3
$T_1P_3U_2$	$T_2P_1U_1$	$T_2P_1U_3$
$T_1P_3U_1$	$T_3P_2U_3$	$T_3P_2U_1$
$T_1P_2U_2$	$T_1P_2U_3$	$T_2P_2U_2$
$T_1P_2U_1$	$T_2P_3U_2$	$T_1P_3U_3$
$T_3P_3U_3$	$T_3P_1U_1$	$T_1P_1U_3$
$T_3P_2U_2$	$T_2P_3U_3$	$T_1P_1U_1$
$T_3P_3U_2$	$T_3P_1U_2$	$T_1P_1U_2$
$T_3P_3U_1$	$T_2P_3U_1$	$T_2P_2U_3$
$T_3P_1U_3$	$T_2P_2U_1$	$T_2P_1U_2$

Preparation of research tools and materials

Soursop fruit obtained from soursop farmers in Kedondong, Pesawaran. The soursop fruit used is soursop fruit in a condition that is not too ripe so that it makes it easier to slice the soursop fruit. Soursop fruit obtained will be cleaned first, so that the fruit is not contaminated with bacteria and dirt. The fruit will be peeled from the skin, the peeled fruit will be sliced 0.5 cm thick.

The process of making soursop chips

The process of making soursop chips by vacuum frying uses 3 temperature levels (75℃, 80℃, and 85℃) and 3 pressure levels (-65 cmHg, -68 cmHg, and -71 cmHg). Using a temperature of 75 ℃ and a pressure of -65 cmHg, because trial and error has been carried

out with the use of a temperature and pressure below 75 ℃ and -65 cmHg produces chips that are not crispy because the water content contained is too high.

Oil drain

Drain the oil on the soursop chips using a spinner for 60 seconds, to reduce the oil content in the chips.

Observation parameters

The parameters analyzed were moisture content, weight loss, frying time, while organoleptic tests were carried out on color, taste, crispness and aroma.

Water content

Testing the water content was carried out using the gravimetric method (BSN, 1992). Measurement of water content is done using an oven. The moisture content is calculated using the following formula:

$$\text{Water content} = \frac{W1}{W} \times 100\%$$

W: is the sample weight before drying (g) and W1: as weight loss after drying (g).

Weight loss

The change in the weight of the chips was measured by weighing the weight of the chips before frying as the initial weight and after frying the chips as the final weight. Weight change can be measured by the following formula:

$$\text{Weight loss} = \frac{(\text{initial weight (g)} - \text{weight after frying (g)})}{\text{Initial weight (g)}} \times 100\%$$

Frying time

The frying time is determined based on the loss of foam during the frying process of the soursop chips, which indicates that there is no more water to be evaporated.

Organoleptic test

The organoleptic test was carried out using the hedonic rating test, based on the method of Meilgarard et al. (1999). Some of the parameters that will be tested organoleptic namely, aroma, color, taste and crispness. The organoleptic test will be carried out by 30 untrained panelists. The panelists will be given a form to provide an assessment of the sample and try the sample directly and then record the results. The organoleptic test rating scale can be seen in Table 2.

Table 2. Organoleptic test rating scale

Parameters	Criteria	Score
Aroma	Really like	5
	Like	4
	Rather like	3
	Dislike	2
	Very dislike	1

Taste	Really like	5
	Like	4
	Rather like	3
	Dislike	2
	Very dislike	1
Crispness	Really like	5
	Like	4
	Rather like	3
	Dislike	2
	Very dislike	1
Color	Really like	5
	Like	4
	Rather like	3
	Dislike	2
	Very dislike	1

Weighting

The best soursop chips were obtained using a weighting calculation using the panelist organoleptic test on soursop chips from calculating the weight of the assessment of each sample. Quality criteria are calculated from the average rating score using the following formula:

$$\% \text{ Weighting} = \frac{\text{rating score average}}{\sum n} \text{ x } 100\%$$

$\sum n$ is the total score 1-4. Then determine the value of the weighting test which is the sum of the multiplication of the average value of 4 parameters (crispness, taste, color, and aroma) from the results of the organoleptic test with the percentage of weight or calculated by the following formula:

Weighting test = (% weight x crispness score) + (% weight x taste score) + (% weight x color score) + (% weight x aroma score)

The best product is the product with the highest weighting test value.

Data analysis

Data analysis was performed using Microsoft Excel software with the ANOVA method. If there is a significant difference then proceed with the LSD test (least significant difference) and then presented in graphic form and description.

RESULTS AND DISCUSSION

Water content

The results of the water content analysis are presented in Figure 1. Based on the results of the analysis of the water content of soursop chips, the smallest water content was found in the frying treatment with a temperature of 85 ℃ and a pressure of -71 cmHg which was 4.33% and the highest water content was found in the treatment of 75 ℃ and -65 cmHg with a water content of 7. 44%. The results of the ANOVA show a significant

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effect where F hit > F table, then it is continued with the LSD (Lessest Significant Difference) follow-up test. The results of the LSD further test on the treatment showed that at 85 ℃ it was significantly different from 75 ℃, while at 80 ℃ it was not significantly different from 75 ℃ or 85 ℃. The results of the LSD follow-up test in the pressure treatment showed that at a pressure of -65 cmHg it was significantly different from -68 cmHg and -71 cmHg. The pressure of -68 cmHg is not significantly different from the pressure of -71 cmHg

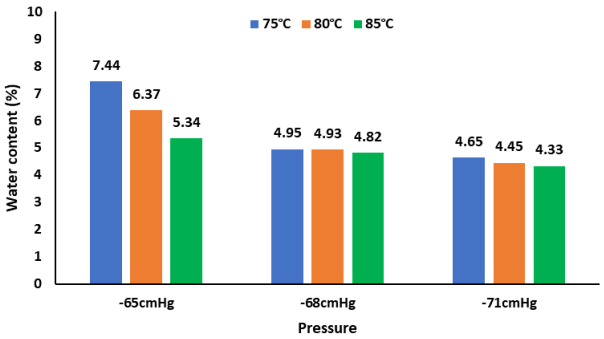

Figure 1. Graph of water content of soursop chips

According to Panuntun (2017), the water content of a product can affect the taste and texture of the product. According to Tumbel (2017), the presence of water content in chips affects the appearance and shelf life of chip products.

Weight loss

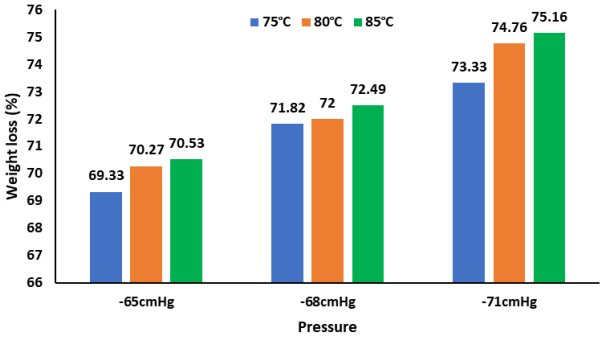

Figure 2. Soursop chips weight loss graph

Based on the results of the analysis of soursop chips weight loss, the smallest weight loss was found in the frying treatment with a temperature of 75 ℃ and a pressure of -65 cmHg which was 69.33% and the highest weight loss was found in the treatment of 85 ℃ and a pressure of -71 cmHg with a weight loss of 75, 16%. The results of the ANOVA show a significant effect where F hit > F table, so that it is continued with the LSD (Lessest Significant Difference) further test. The results of the LSD further test on the treatment showed that at 85 ℃ it was significantly different from 75 ℃, while at 80 ℃ it was not significantly different from 75 ℃ or 85 ℃. The results of the LSD follow-up

test in the pressure treatment showed that at a pressure of -65 cmHg it was significantly different from -68 cmHg and -71 cmHg. The pressure of -68 cmHg is not significantly different from the pressure of -71 cmHg.

Length of frying time

Figure 3. shows that the shortest frying time was found in the frying treatment with a temperature of 85 ℃ and a pressure of -71 cmHg, namely for 39 minutes and the longest frying time was in the treatment of 75 ℃ and -65 cmHg with a frying time of 49 minutes. The results of the ANOVA show a significant effect where F hit > F table, so that it is continued with the LSD (Lessest Significant Difference) further test. The results of the LSD further test on the treatment showed that at 85 ℃, 75 ℃ and 80 ℃ they were significantly different from each other. The results of the LSD follow-up test in the pressure treatment showed that at a pressure of 65 cmHg, -68 cmHg and -71 cmHg were significantly different from each other.

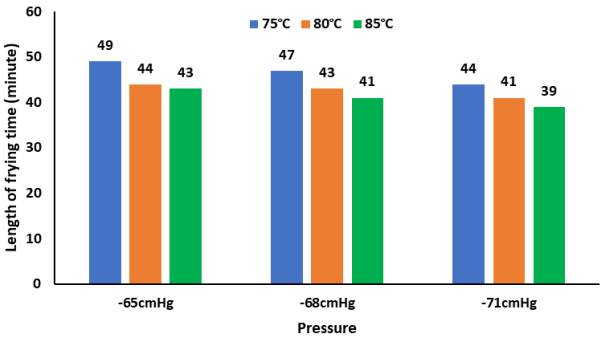

Figure 3. Graph of soursop chips frying time

Organoleptic Test

Taste

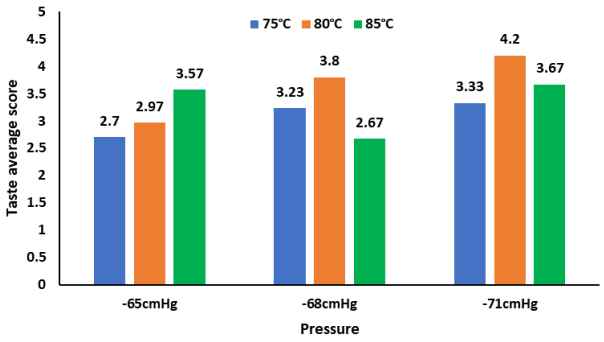

Figure 4. The effect of frying temperature and pressure on the taste of soursop chips

The test results for the level of preference for the taste of soursop chips obtained a score between 2.70 (dislike) to 4.20 (like). The highest taste score was obtained from soursop chips treated at 80℃ and -71 cmHg, while the lowest taste score was obtained

by chips treated at 85℃ and -68 cmHg. According to Afrozi et al., (2018), the higher the temperature and frying time, the panelist's assessment of the taste of chips is higher.

The results of the ANOVA test conducted on the preference level test for soursop chips with a 95% confidence level, stated that F Count (11.5174) was greater than F Table (1.9784) which means that the temperature and pressure treatment had a significant effect on the level of preference for the taste of chips. Further LSD test results on the treatment showed that chips treated at 85℃ and -68 cmHg were not significantly different from chips treated at 75℃ and -65 cmHg but significantly different from chips treated at 80℃ and -71 cmHg. Chips treated at 75℃ and -68 cmHg were not significantly different from chips treated at 85℃ and -68 cmHg. The increase in taste score tends to increase with increasing temperature. The level of preference for taste is related to the length of time of frying where the longer the frying time the lower the level of preference for the taste of the chips.

Crispnes

The results of the preference level test for the crispiness of soursop chips obtained scores between 3 (rather like) to 4.37 (like). The highest crispness score was obtained from soursop chips treated at 85℃ and -71 cmHg, while the lowest crispness score was obtained by chips treated at 75℃ and -65 cmHg.

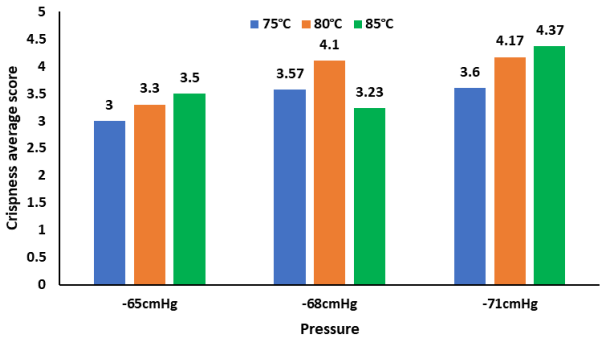

Figure 5. Effect of frying temperature and pressure on the crispness of chips

The results of the ANOVA test conducted on the soursop chips crispiness level preference test with a 95% confidence level, stated that F Count (14.3786) was greater than F Table (1.9784) which means that the temperature and pressure treatment had a significant effect on the chips' preference level. Because the results of the ANOVA showed a significant effect, it was continued with the LSD follow-up test. LSD test results further on the treatment showed that the chips treated at 85℃ and -71 cmHg were not significantly different from the chips treated at 80℃ and -68 cmHg and 80℃ and -71 cmHg. Chips treated at 75℃ and -65 cmHg were significantly different from chips treated at 75℃ and -71 cmHg. The increase in crispness score tends to increase with increasing temperature and pressure. The crispness score of soursop chips tends to increase along with the lower the water content contained in the chips.

Aroma

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The results of the ANOVA test conducted on the preference level test for soursop chips aroma with a 95% confidence level, stated that F Count (5.1616) is greater than F Table (1.9784), which means that temperature and pressure treatment have a significant effect on the level of preference for AROM chips.

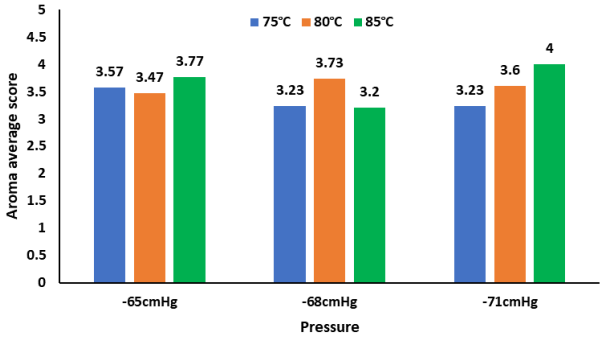

Figure 6. The effect of frying temperature and pressure on the aroma of soursop chips

The results of the ANOVA test conducted on the preference level test for soursop chips aroma with a 95% confidence level, stated that F Count (5.1616) is greater than F Table (1.9784), which means that temperature and pressure treatment have a significant effect on the level of preference for AROM chips.

Further LSD test results on the treatment showed that the chips treated at 75°C and -65 cmHg were not significantly different from the chips treated at 80°C and -71 cmHg. Chips with 75°C and -68 cmHg treatment, 75°C and -71 cmHg treatment and 85°C and -68 cmHg treatment were not significantly different from each other.

Color

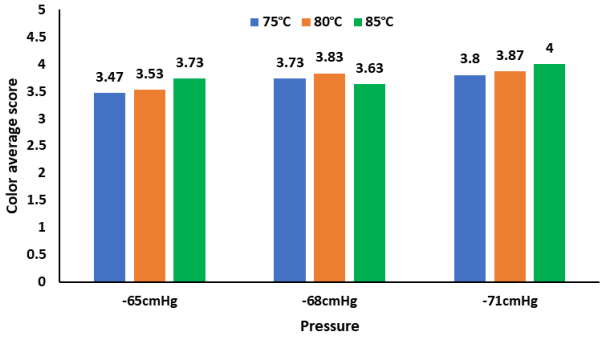

Figure 7. Effect of frying temperature and pressure on the color of soursop chips

Test results for the level of preference for the color of soursop chips obtained a score between 3.47 (rather like) to 4 (like). The highest color score was obtained from soursop chips treated at 85°C and -71 cmHg, while the lowest color score was produced by chips treated at 75°C and 65 cmHg.

The results of the ANOVA test conducted on the soursop chip color preference test with a 95% confidence level, stated that F Count (2.2841) was greater than F Table

(1.9784) which means that the treatment of temperature and pressure had a significant effect on the color preference of chips. Further LSD test results on the treatment showed that the chips treated at 75℃ and -65 cmHg were significantly different from the chips treated at 85℃ and -71 cmHg. However, the treatment with other temperatures and pressures were not significantly different from each other.

Weighting

The weighting is calculated from the panelist's acceptance test for soursop chips and calculating the weight of the assessment, namely the importance of soursop chips from soursop chips. The organoleptic parameters given to the panelists were color, taste, crispness and aroma. Then the panelists sort each parameter based on its level of importance.

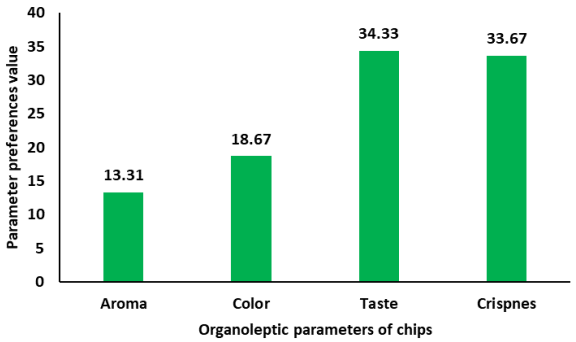

Figure 8. Preferences value of soursop chips

Determination of the best frying temperature and pressure treatment from the results of the hedonic test with a weighting test. Panelists were given a questionnaire regarding the parameters of the chips, namely aroma, taste, crispness and color. Then the panelists were asked to sort each parameter based on its level of importance.

Sort from 4 = very important, 3 = important, 2 = somewhat important and 1 = not important. The results of the questionnaire showed that the panelists tended to rank flavor in first place (34.33%), crispness in second place (33.67%), aroma in third place (18.67%) and color in fourth place (15.33%) . The average preference value of each parameter will be multiplied by the weight of each parameter.

According to the results of the weighting of the soursop chips product which had a score acceptable to the panelists obtained at a temperature treatment of 80 ℃ with a pressure of -71 cmHg and a treatment with a temperature of 85 ℃ and a pressure of -71 cmHg, the products with the lowest score were found in products with a temperature of 75 ℃ with a pressure 65 cmHg. The results of this assessment are closely related to the level of preference for the taste and crispness of the soursop chips. The results of measuring the water content show that most of the treatments have fulfilled the maximum of the water content contained therein except for the treatment with a pressure of -65 cmHg where the water content exceeds 5% according to the National Standardization Agency (BSN) (1996) with SNI number 01-4304 -1996. In addition, the selection of the best treatment is also based on the length of time of frying, frying with a shorter time will save energy and time. So according to the results obtained the treatment that is considered

the best is at a temperature of 80 ℃ with a pressure of -71 cmHg with a long frying time of 41 minutes.

CONCLUSION

Based on the results of the study, it can be concluded that the best soursop chips frying temperature and pressure treatment is found in the temperature treatment of 80℃ with a pressure of -71 cmHg with a water content which is the result of 4.45%, crispness score 4.17 (likes), taste score 4.2 (like), aroma score of 3.6 (rather like), and color score of 3.87 (rather like) fulfill the National Standardization Agency (BSN) with SNI number 01-4304-1996. Frying time is affected by frying temperature and pressure, the higher the temperature and the lower the pressure, the shorter the frying time.

REFERENCES

Afrozi, S., Mufarida, N.A., & Sofiyah, R. (2018). Hubungan optimalisasi suhu dan waktu penggorengan pada mesin vacuum frying terhadap peningkatan kualitas keripik pisang kepok. *Jurnal Proteksion. Jurnal Kajian Ilmiah Dan Teknologi Teknik Mesin, 2*(2), 43-52.

Arum, A. P. (2012). *Pengaruh Waktu dan Suhu Pada Pembuatan Keripik Melon Dengan Vaccum Frying*. Fakultas Teknik, Universitas Negeri Makassar. Makassar.

Ayustaningwarno, F., van Ginkel, E., Vitorino, J., Dekker, M., Fogliano, V., & Verkerk, R. (2020). Nutritional and physicochemical quality of vacuum-fried mango chips is affected by ripening stage, frying temperature, and time. *Frontiers in Nutrition*, *7*(95).

Belkova, B., Hradecky, J., Hurkova, K., Forstova, V., Vaclavik, L., & Hajslova, J. (2018). Impact of vacuum frying on quality of potato crisps and frying oil. *Food Chemistry*, *241*, 51-59

BSN (Badan Standar Nasional). (1992). SNI 01-2891-1992 Cara uji makanan dan minuman.

BSN (Badan Standar Nasional). (1996). SNI 01-4304-1996 Keripik nanas.

Diamante, L.M., Shi, S., Hellmann, A., & Busch, J. (2015). *Vacuum frying foods:* Products, process and optimization. *International Food Research Journal, 22*(1), 15–22.

Hilapad, M.R., Esguerra, E.B., & Castillo-Israel, K.A.T. (2020). Optimization of processing parameters for vacuum fried oyster mushroom (Pleurotus ostreatus (Jacquin) P. Kummer). *Food Research.*

Jamaluddin. (2011). *Pengaruh Suhu dan Tekanan terhadap Penguapan Air Perubahan Volume dan Rasio Densitas Keripik Buah Selama dalam Penggorengan Vakum*. Fakultas Teknik Universitas Negeri Makassar. Makassar.

Maity, T., Bawa A.S., & Raju, P.S. (2014). Effect of vacuum frying on changes in quality attributes of jackfruit (Artocarpus heterophyllus) bulb slices. *International Journal of Food Science.*

Meilgaard, M., Civille, G. V., & Carr, B.T. (1999). *Sensory Evaluation Techniques*. CRC Press. New York. 416.

Moreira, R.G. (2014). Vacuum frying versus conventional frying – An overview. *European Journal of Lipid Science and Technology*, *116*(6), 723-734.

Panuntun, E. U. (2017). *Pengujian Meter Kadar Air KETT PM 410 dan Moisture Analyzer HR 83 dengan Metode Referensi Oven Menggunakan Sampel Jagung*. [Disertasi].Universitas Gadjah Mada. Yogyakarta.

Septia, P., Nainggolan, J. R., & Ridwansyah. (2016). *Pengaruh Perbandingan Bubur Buah Sirsak (Annona Muricata L.) Dengan Bubur Bit (Beta Vulgaris) dan Konsentrasi Gum Arab Terhadap Mutu Fruit Leather,4*. [Disertasi]. Universitas Sumatera Utara. Medan.

Tumbel, N. (2017). Pengaruh suhu dan waktu penggorengan terhadap mutu keripik nanas menggunakan penggoreng vakum. *Jurnal Penelitian Teknologi Industri*, *9*(1), 9-22.