

6.3. Technology Development of Salak (Salacca Zalacca) Chips With Vacuum Frying Machine Base On Expert System In Kramat-Bangkalan Regency

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Submission date: 05-Jan-2021 11:19AM (UTC+0700)

Submission ID: 1483164172

File name: 6.3._Technology_Development_of_Salak.pdf (506.44K)

Word count: 3660

Character count: 19851

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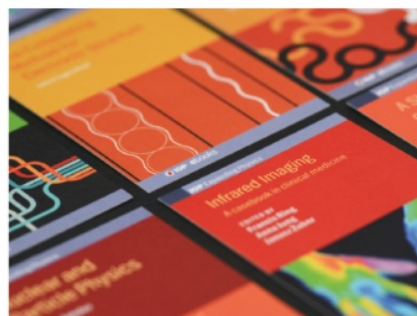
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To cite this article: D F Rosida *et al* 2018 *J. Phys.: Conf. Ser.* **953** 012240

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¹Technology Development of Salak (*Salacca Zalacca*) Chips With Vacuum Frying Machine Base On Expert System In Kramat-Bangkalan Regency

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Abstract. Agropolitan Program is one form of regional development to improve agribusiness system and effort to improve the welfare of the community. One of the leading commodities in Bangkalan agroclimates is salak which is a potentially very large commodity to be developed. Salak commodities in Kramat Bangkalan Indonesia have developed various salak produced such as dates of salak, syrup and dodol salak. Salak chips was the target of innovation from processed salak. The Production of salak chips using frying technology with vacuum system to obtain crunchy chips. To get the results need to be developed synergy technology to combine the process conditions and the right system in producing good quality salak chips. Bangkalan Regency is the potential to continue to develop products using a variety of salak to the processed form of vacuum frying machine based on expert system so that the resulting product would be great texture, aroma and taste. This will make the area of Bangkalan, Indonesia be more independent in producing and increasing revenue.

1. Introduction

Vacuum frying is an alternative way to improve the quality of the fried food and could⁴ reduce the final oil uptake in the product. The product is heated at low pressure thus decreasing the boiling points of the frying oil and the water in the product. Moreover, the absence of air during vacuum frying may inhibit lipid oxidation and enzymatic browning, and therefore, the color and nutrients of samples can be largely preserved. Many food research projects involving snack food industries therefore attempt to understand oil uptake during the vacuum-frying process in order to control and reduce¹⁴ fat content of fried products without deteriorating their desirable organoleptic characteristics[1]. Among several deep-fat frying technologies, vacuum frying has a significant strategic importance for future fried food manufacturing. The technology offers significant benefits such as the improvement of fried product safety and quality and reduced oil oxidation because of the low-temperature processing. The recent studies and interests in vacuum frying applications[2].

Vacuum frying is an excellent alternative to conventional frying which offers significant benefits such as the improvement of fried product safety and quality and reduced oil oxidation because of the low-temperature processing [2]. Vacuum frying is a deep-fat frying process which is carried out in a closed system, below the atmospheric pressure, substantially reducing the boiling point of water and, hence, the frying temperature. The low frying temperatures and minimal exposure to oxygen are responsible for most of the benefits of the fried products, which include nutrient preservation [3], oil quality protection [4], and reduction in toxic compound generation [5].

The effect of frying temperatures and durations on the quality of vacuum fried jackfruit (JF) chips was evaluated. Moisture content and breaking force of JF chips decreased with increase in frying temperature and time during vacuum frying whereas the oil content increased. The frying time for JF chips was found to be 30, 25, and 20 minutes at 80, 90, and 100°C, respectively. JF chips fried at higher temperature resulted in maximum shrinkage (48%). Frying under vacuum at lower temperatures was found to retain bioactive compounds such as total phenolics, total flavonoids, and total carotenoids in JF chips [6].

Scant information is available on this topic because scientists are only just beginning to perform research in this field. However, it is clear that vacuum frying of non-traditional fruits and vegetables has great potential. In this respect, salak are an interesting raw material to be studied because they are the most important source of dietary tannin. In addition to acting as natural compounds, these compounds have been linked to the prevention of certain types of cancer and degenerative and chronic diseases. That there are objective conditions of low productivity-based processed salak product caused by weak due to lack of human resources and information technology mastery, and the poor quality of entrepreneurial business people. Issues of human resource development and productivity further complicated because most micro businesses with less facilitated access to information, technology and innovation. To the importance of product diversification salak need to be explored further so that more people-based foods like salak fruit. To improve product quality salak product is needed diversification of production machinery in this case to produce various salak product as salak chips. One of the required machinery is vacuum frying with LPG heaters that use control techniques based on expert system.

2. Method

Efforts to accelerate the realization of salak chips can be done preservation movement than with providing information support of scientific study and rational accurate about the benefits and security for consuming. Methods that can be done is by the method of approach is to facilitate the improvement of the skills of businessmen salak products in the village Kramat-Bangkalan to conduct training. Methods of training include:

- a. Lecture method is the provision of basic theory in the processing of food products that are innovative, durable, safe, high nutritional value and can be made public as well as having economic value added.
- b. Practice methods of providing training that focused on the ability of community skills in innovative product processing. This training emphasizes the active participation.
- c. Methods of assistance for sustainable business activities.

In the manufacture of various food products based on the required salak chips frying that use specific time and temperature can be set so that it will produce good food and good quality in terms of nutrition and appearance. Differences in temperature due to the use of each type of product used to produce a certain temperature crispness with nice quality. For that use a drying based on expert system. Expert system that applied this dryer is imitating the engine manually performed by a salak product expert.

3. Results and Discussion

The steps undertaken by interviewing an expert salak chips to gain basic knowledge of an expert manufacturer. This knowledge will be combined with the configuration of the device used, for example the problem of sensors, actuators and so on to build an expert system accordingly. Given the process of moving from an expert knowledge into the system and perhaps the discrepancy of the device used, the testing and evaluation of an expert system that has been created. The evaluation results confirmed turning to an expert and is also used to improve the system configuration used. Expert system includes several aspects, namely :

1) Knowledge Base

- Part of the expert system that contains the domain knowledge, ie the knowledge needed to understand, formulate and solve problems.
- Consists of two basic elements :
 - Facts, circumstances and issues related theory
 - Specific heuristics or rules, which directly uses knowledge to solve specific problems.

2) Working Memory

Part of the expert system that contains the facts of the matter are found in a session, that the facts about the problems found in the consultation process

3) Inference Engine - Intelligent Machines

Processor on an expert system matches facts that exist in the working memory domain knowledge contained in the knowledge base, to draw conclusions from the problems encountered. Human thought process is modeled in an expert system on module called Inference Engine.

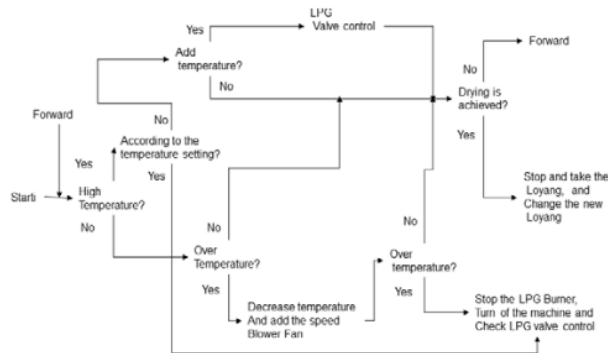


Figure 1. Decision Diagram Expert System

Expert systems are made can not be separated from the way a person thinks salak chips, maker expert who is later revealed in the form of decision diagrams.

The impact of vacuum frying process

The loss of moisture

The frying exhibited a classical drying process. The drying process of foods is generally characterized by three distinct periods. The first is an initial heat-up period during which the wet solid material absorbs heat from the surrounding media. The product is heated up from its initial temperature to a temperature where the moisture begins to evaporate from the food. In vacuum frying, this initial heat-up period is very short and therefore difficult to quantify.

At a vacuum pressure of 3.115 kPa, for example, the boiling point of water is around 25 °C. The temperature in the potato slice is slightly higher than the boiling point of water due to the presence of

some solutes. Since the temperature of the potato slices prior to frying was at room temperature (23–24 °C), the slices only had to warm up a few degrees for the water to start boiling. For this reason, the heat-up period in vacuum frying is very short (Garayo and Moreira, 2002).

The second drying period is known as the constant rate period. Here, the rate of drying is limited by the rate at which heat is transferred from the drying medium to the product. The constant drying conditions continue as long as the food surface remains wetted with water. In the case of potato chips fried under vacuum frying, we could not observe any constant rate period (Garayo and Moreira, 2002).

When the moisture level in the product is so low that its surface is no longer wetted, the drying rate decreases entering the falling rate period. During this period, drying rate is controlled by moisture diffusion mechanisms. The water during this period is held in the material by multi-molecular adsorption and capillary condensation (Toledo, 1991).

Potato chips fried at an oil temperature 144 °C and 3.115 kPa took the shortest time to fry (360 s). Potato chips fried at the same pressure and at 132 and 118 °C, took 480 and 600 s to fry, respectively. Decreasing the oil temperature increased the frying time of potato chips fried under vacuum as expected. The same behavior was observed for the other vacuum pressures (Garayo and Moreira, 2002). Gamble, Rice, and Selman (1987) reported that potato chips fried at atmospheric conditions at higher temperatures resulted in an initial rapid fall followed by a continuous drying period. The point, where the drying rate in the initial 150 s of frying was higher for 144 °C than for 132 °C. The difference was even more pronounced when comparing the drying rate at 132 and 118 °C at all pressures.

Effect of acrylamide production

The acrylamide content in chips is affected by commodity cultivars. Selection of chipping cultivars with low reducing sugar would greatly reduce the acrylamide content in chips. Compared with traditional frying (atmospheric conditions), vacuum frying reduced acrylamide formation in potato chips dramatically by about 94%. Vacuum frying potato slices at 118 °C produced potato chips with low acrylamide content and desirable yellow golden color and texture attributes compared with those fried in the traditional fryer. The frying oil temperature-time combination also affected acrylamide formation significantly in the chips. For the 2 treatments studied, acrylamide formation decreased significantly in potato chips as the frying temperature decreased from 180 °C to 150 °C for the traditional method and from 140 °C to 118 °C for the vacuum frying (Granda, Moreira, and Tichy, 2004).

Effect of oil oxidation.

Deep-fat frying of food is usually performed at high temperature (about 180°C) under atmospheric pressure. Surface darkening may occur even before the food is fully cooked. Some of the fat and oil decomposition products have also been implicated in producing adverse health effects when fried oils degraded with continued use (1,2). Pressure frying is another way of deep-fat frying; food is fried in a closed system under pressure. This increases the boiling points of frying oil and moisture in food, and thus increases the rate of heat transfer to the interior of food and shortens the frying time. Food fried under pressure will usually retain more moisture and flavor. Pressure frying is conducted at high temperature and pressure, it therefore might have adverse effects on the quality of frying oils. In vacuum-frying operations, food is heated under reduced pressure in a closed system that can lower the boiling points of frying oil and moisture in food. Water in the fried food can be rapidly removed when the oil temperature reaches the boiling point of water. Because food is heated at lower temperature and oxygen content during vacuum frying (4), the natural color and flavor can be preserved. Vacuum frying also has less adverse effects on oil quality.

Vegetables and fruits are generally dehydrated by freeze drying, a process that can maintain their original flavor and color. This operation, however, is energy and time consuming. Therefore, production of dehydrated vegetables and fruits with high quality in a short time is an important issue

for food processors. Vacuum frying of fruits and vegetables slices may be a good alternative to process hydrated fruits and vegetables.

During frying, oil or fat is exposed to air, water, and heat. Therefore, thermal, oxidative, and hydrolytic decomposition of the oil may take place. Fats and oils are oxidized to form hydroperoxides, the primary oxidation products. These peroxides are extremely unstable and decompose via fission, dehydration, and formation of free radicals to form a variety of chemical products, such as alcohols, aldehydes, ketones, acids, dimers, trimers, polymers, and cyclic compounds.

The palm oil and lard possess greater thermal stability than soybean oil. The decrease in C18₂/C16:0 ratio was greater for soybean oil than the other two oils. Of the assessment methods used, peroxide value, carbonyl value, total polar components, and dielectric constant all showed good correlation with frying time and between each other. Viscosity was suitable to assess vacuum-fried lard and soybean oil, but not palm oil. The measurement of dielectric constant, on the other hand, appeared to be unsuitable to assess vacuum-fried soybean oil (Shyi-Liang Shyu, Lung-Bin Hau, and Lucy Sun Hwang 1998). The vacuum frying can reduce oil content by nearly 50% (d.b.) and preserve approximately 90% of trans a-carotene and 86% of trans b-carotene. This process also allowed for the raw carrot colour to be preserved, which was reflected by good correlations between a* and trans b-carotene content, b* and trans a-carotene content, and hue and total carotenoid content (Dueik et al 2010). In order to compare vacuum and atmospheric frying, Mariscal and Bouchon (2008) defined the term 'equivalent thermal driving force', which is the difference between the oil temperature and the boiling point of water at the working pressure. The authors used several equivalent thermal driving forces (40 °C, 50 °C and 60 °C) when frying apple slices under atmospheric or vacuum conditions (4.4 in. Hg). Their experiments showed that vacuum fried apple slices absorbed slightly less oil, and presented better results for colour preservation than atmospheric fried samples.

Water activity (a_w)

The samples reached a water activity (a) average value of approximately 0.44. This value matches the results obtained by Katz and Labuza (1981), who found that potato crisps sensory acceptability decreases markedly above a critical value of 0.47. Furthermore, no significant differences were found amongst the samples. Water activity affects the stability of dehydrated foods because it determines both chemical reaction rates and microbial activity. The limiting value of a for the growth of any microorganism is around 0.6. Below this value, food spoilage is mainly due to enzymatic and chemical reactions, such as oxidation (Adams & Moss, 1995). The rate of oxidation may rise as water content increases since water can enhance reactant mobility and bring catalysts into solution. In relation to carotenoid stability, Lavelli, Zaroni, and Zaniboni (2007) showed that both trans a- and b-carotene from dehydrated carrots present their maximum stability at a values between 0.34 and 0.54. These results confirm previous findings by other authors (Baloch, Buckle, & Edwards, 1977)

Texture

Frying of raw vegetables induces major changes in their micro-structure, which in turn determines their final physical and sensory properties. The most important textural attribute of crisps and chips is crispness, which denotes freshness and high quality. A crisp should be firm and snap easily when bent, emitting a crunchy sound (Krokida, Oreopoulou, Maroulis, & Marinos-Kouris, 2001). During frying, vegetable tissues show an initial softening that is followed by hardening due to the progressive development of a dehydrated crust. In order to incorporate both phenomena, Pedreschi and Moyano (2005) modelled textural changes (normalised maximum force) during frying by means of two terms. The first describes the softening of the tissue for short frying times (fast phase) and the second describes a hardening dependent component (slow phase), which is a function of the square of the frying time and gains relevance at longer frying times.

4. Conclusion

The Production of salak chips using frying technology with vacuum system to obtain crunchy chips. To get the results need to be developed synergy technology to combine the process conditions and the right system in producing good quality salak chips. Bangkalan Regency is the potential to continue to develop products using a variety of salak to the processed form of vacuum frying machine based on expert system so that the resulting product would be great texture, aroma and taste.

References

- [1] Andrés-Bello, A., P. García-Segovia., J. Martínez-Monzó. 2011. Vacuum Frying: An Alternative Obtain High-Quality Dried Products. *Food Engineering Reviews* June 2011, 3:63. Springer
- [2] Garayo, J., Moreira, R. 2002. Vacuum frying of potato chips. *Journal of Food Engineering* 55 (2002) 181–191
- [3] P. F. da Silva and R. G. Moreira, "Vacuum frying of high- quality fruit and vegetable-based snacks," *LWT—Food Science and Technology*, vol. 41, no. 10, pp. 1758–1767, 2008.
- [4] S.-L. Shyu, L.-B. Hau, and L. S. Hwang, "Effect of vacuum frying on the oxidative stability of oils," *Journal of the American Oil Chemists' Society*, vol. 75, no. 10, pp. 1393–1398, 1998.
- [5] C. Granda, R. G. Moreira, and S. E. Tichy, "Reduction of acrylamide formation in potato chips by low-temperature vacuum frying," *Journal of Food Science*, vol. 69, no. 8, pp. E405–E411, 2004.
- [6] Tanushree Maity, A. S. Bawa, and P. S. Raju. 2014. Effect of Vacuum Frying on Changes in Quality Attributes of Jackfruit (*Artocarpus heterophyllus*) Bulb Slices. *International Journal of Food Science* Volume 2014
- [7] Toledo, R. R. (1991). *Fundamentals of food process engineering* (2nd ed.). New York: Van Nostrand Reinhold Company, Inc
- [8] Gamble, M. H., Rice, P., & Selman, J. D. (1987). Relationship between oil uptake and moisture loss during frying of potato slices from the UK tubers. *International Journal of Food Science and Technology*, 22, 233–241.
- [9] Granda, C., Moreira, R.G and Tichy, S. Reduction of Acrylamide Formation in Potato Chips by Low-temperature Vacuum Frying. Vol. 69, Nr. 8, 2004—*Journal of Food Science*
- [10] Shi-Liang Shyu, Lung-Bin Hau, and Lucy Sun Hwang. 1998. Effect of Vacuum Frying on the Oxidative Stability of Oils. *JAOCS* 75, 1393–1398
- [11] Dueik V., Robert. P., Bouchon. P., 2010. Vacuum frying reduces oil uptake and improves the quality parameters of carrot crisps. *Food Chemistry* 119 (2010) 1143–1149
- [12] Mariscal, M., & Bouchon, P. (2008). Comparison between atmospheric and vacuum frying of apple slices. *Food Chemistry*, 107(4), 1561–1569.
- [13] Katz, E. E., & Labuza, T. P. (1981). Effect of water activity on the sensory crispness and mechanical deformation of snack food products. *Journal of Food Science*, 46, 403–409.
- [14] Adams, M. R., & Moss, M. O. (1995). *Food microbiology*. Cambridge: The Royal Society of Chemistry.
- [15] Lavelli, V., Zanoni, B., & Zaniboni, A. (2007). Effect of water activity on carotenoids degradation in dehydrated carrots. *Food Chemistry*, 104, 1705–1711.
- [16] Baloch, A. K., Buckle, K. A., & Edwards, R. A. (1977). Stability of b-carotene in model systems containing sulphite. *Journal of Food Technology*, 12, 309–316.
- [17] Krokida, M. K., Oreopoulou, V., Maroulis, Z. B., & Marinou-Kouris, D. (2001). Effect of pre-treatment on viscoelastic behaviour of potato strips. *Journal of Food Engineering*, 50, 11–17.
- [18] Pedreschi, F., & Moyano, P. (2005). Oil uptake and texture development in fried potato slices. *Journal of Food Engineering*, 70, 557–563.

Acknowledgment

This research was funded by the Directorate General of Higher Education, Ministry of Education and Culture through the community service programs (Hi-Link 2017)

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