Optimization Process of Soymilk Jelly Candy with Alkaline Catfish Gelatin by Response Surface Methodology

Metha Monica[1], Hajar Setyaji[2]

(1) Animal Husbandry, Jambi University
(2) Agroecotechnology, Jambi University

✉ Corresponding author:
methamonica@yahoo.com

Abstrak

Susu kedelai merupakan bahan makan yang kaya nutrisi, bebas laktosa, tidak alergi dan memiliki daya cerna yang tinggi. Susu kedelai dapat digunakan sebagai alternatif susu untuk vegetarian, alergi susu sapi dan mereka yang memiliki kolesterol tinggi. Susu kedelai dapat diolah menjadi berbagai bentuk makanan dan minuman seperti es krim, permen jeli, mayones dan produk komersial lainnya. Tujuan penelitian: melakukan optimasi penggunaan gelatin ikan patin alkali (proses alkali) pada permen jeli susu kedelai. Desain Eksperimental: a. Pembuatan Permen Jeli Kedelai dengan 3 (tiga) faktor yang diamati adalah: konsentrasi gelatin (%) (X1) (0; 1; 2), suhu pemanasan (o) (X2) (70; 80; 90), waktu penyimpanan (hari) (X3): (0 ; 10 ; 20). Dianalisis secara statistik menggunakan persamaan orde kedua RSM (Response Surface Methodology) dengan hasil fitting R^2 = 0,99 dan kesalahan 10%. Hasil penelitian menunjukkan: Proses Jelly Candy susu kedelai secara optimal tercapai pada 1%, 80^{o}C, dan waktu penyimpanan 10 hari dengan karakteristik kimia: Protein berkisar antara 2,331715 - 2,69869 %, kandungan lemak 0,409357 - 13,1054 %, pH berkisar antara 3,95 - 5, kadar air antara 8,8817 - 15. %, dan gula pereduksi sekitar 44.4897 - 87.7882 %.

Kata Kunci: Gelatin, Ikan patin, RSM, susu kedelai, Permen Jelly.

Abstract

Soymilk is nutrient-rich, lactose-free, non-allergenic and has high digestibility. Soymilk can be used as an alternative to milk for vegetarians, cow's milk allergies and those with high cholesterol. Soymilk can be processed into various forms of food and beverages such as ice cream, jelly candy, mayonnaise and other commercial products. Research objectives: Applied of alkaline catfish gelatin (alkaline process) to soymilk jelly candy. Experimental Design: a. Making Soymilk Jelly Candy with 3 (three) factors observed are: gelatin concentration (%) (X1) (0; 1; 2), heating temperature (o) (X2) (70; 80; 90), storage time (days) (X3): (0 ; 10 ; 20). Analyzed statistically using the RSM (Response Surface Methodology) second order equation with fitting results R^2 = 0.99 and 10% error. Result of the research shows: Optimally process of soymilk Jelly Candy was reach at 1%, 80oC, and 10 days storage time with chemical characteristics: Protein ranged between 2.331715 - 2.69869 %, fat content was 0.409357 - 13.1054 %, PH ranged between 3.95 - 5, moisture content between 8.8817 - 15. %, reducing sugar was about 44.4897 - 87.7882 %

Keyword: Gelatin, Catfish, RSM, Soymilk, Jelly Candy

INTRODUCTION

One of the local resources in Jambi Province is catfish (Pangasius sp), where catfish meat is exported while catfish skin is not utilized or just thrown away as waste. Catfish skin waste can be processed into products that have high economic value so that this effort can help increase the

income of fishermen and fish processing. Catfish skin has the potential to be utilized as gelatin and has economic value. Because fish skin and bones as a source of gelatin cover 10-20% of the total weight of the fish body. So far, commercial gelatin raw materials are mostly from pigs. The use of pork gelatin is an obstacle to the development of food products in countries where the majority of the population is Muslim as is the case in Indonesia. According to Zhang et al. (201) that patin fish gelain (Pangasius hyphothalmus) produces better gelatin than commercial gelatin (Zhang et al., 2011). According to Badli & Howell (2006); Ratnasari et al (2013) said the physical quality of freshwater fish is better than marine fish such as gel strength, texture and viscosity. According to Colmenero et al, (2017) stated that gelatin is a hydrocolloid-shaped product hydrolyzed from animal or livestock collagen proteins that are hydrophilic which are found in many parts of the skin, bones and animal tissues.

According to Karim et al. (2009) that gelatin is a ge-forming agent obtained from whites, bones and connective tissue of animals such as cows, chickens, pigs and fish, where gelatin has more elastic properties and vice versa, when heated it will melt and when cooled it will form a gel again. According to Casanova et al (2020) where gelatin can be obtained by partial thermal hydrolysis of collagen and contains high essential hydrocolloids. Gelatin is widely used from pig skin, cow skin and cow bones.

One of the sub-systems of food security development is the consumption sub-system which aims to ensure that every household consumes food in sufficient, nutritious and safe quantities. With this sub-system, soy milk is utilized because soy milk has higher protein (3.6 g) compared to cow's milk (2.9 g). In addition, soy milk can be made with easy and simple technology so that the costs required are also relatively low. Soy milk is nutrient-rich, lactose-free, non-allergenic and has high digestibility. Soy milk can be used as an alternative to milk for vegetarians, cow's milk allergies and those with high cholesterol. Because soy milk is also cholesterol and lactose free. Soy milk can be processed into various forms of food and beverages such as ice cream, jelly candy, mayonnaise and other commercial products.

Jelly candy is a soft-textured confectionery; which is processed by the addition of hydrocolloid components, including agar-agar, gum, pectin, carrageenan starch, gelatin, etc. which are used for texture modification to produce chewy products (Badan Standrisassi Nasional, 2008). According to Nuh et al (2020) said that the manufacture of jelly candy uses gelling agents that have a reversible reaction or if the gel is heated it will form a liquid and when cooled it will form a gel again. Jelly candy and ice cream usually use stabilizers such as gelatin, guar gum, carrageenan. Jelly candy is a soft-textured candy that is processed by adding hydrocolloid components such as agar, gum, pectin, starch, carrageenan, gelatin and others which are used for texture modification to produce chewy products. According to Cahyaningrum et al (2021), it is stated that in the jelly candy making industry, food additives that are often used are gelatin, where gelatin is used as an emulsifier, stabilizer, foam-former and film-former. Meanwhile, according to Putri et al. (2023) that jelly candy is a type of confectionery made from a mixture of fruit juice or flavored syrup, sugar and gel formers such as gelatin which produces chewy candy with a variety of flavors and shapes. Likewise, according to Omar et al, (2018) said jelly candy is made by cooking sugar until it reaches the desired solid, then adding gelling ingredients (gelatin, agar-agar, pectin, and carrageenan) then adding flavor and color, and finally printing. Jelly candy also has a clear and transparent appearance and has a certain texture and elasticity.

According with the description above, research is needed to process catfish skin (Pangasius sp) into catfish gelatin (Pangasius sp) and apply it to food products such as soymilk jelly candy.

RESEARCH METHODS

Materials of this study using alkaline catfish gelatin which researcher produce at earlier stage, soymilk, succrose, glucose, citric acid, natrium benzoate. Design of experimental research with RSM to optimization of soymilk jelly candy process with 3 (three) factors observed are:

a. Concentration of gelatin (%): 0 ; 1 ; 2

b. Heating Temperature (^oC): 70 ; 80 ; 90

c. Storage Time (days): 0 ; 10 ; 20

Jelly Candy Production Process: Gelatin (%) is dissolved in water at a temperature of treatment (^oC), stirred until evenly mixed, then add soymilk, sodium benzoate and gelatin dryer, glucose, granulated sugar and water heated at a low temperature until it reaches 100^o C in a separate pan, then added citric acid while continuing to stir until it reaches temperature 115^o C, turn off the stove, then add the gelatin mixture, stir until evenly mixed, add flavor and continue with stirring the mixture again, then pour it into the mold and leave it at room temperature according to the treatment. Soymilk jelly candy then analysis of: pH, water content, protein, fat, and reducing sugar content.

RESULTS AND DISCUSSION

Protein Content of Soymilk Jelly Candy

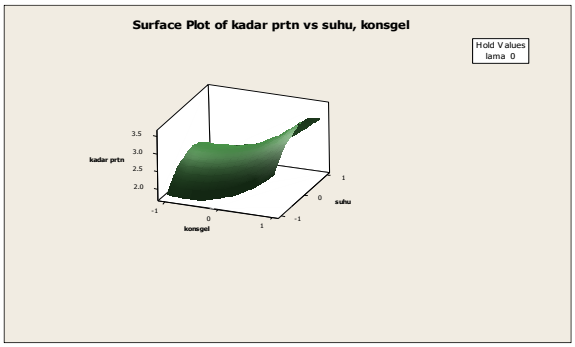


Figure 1. Protein Content of Soymilk Jelly Candy

The protein of soymilk jelly candy ranged from 2.331715 - 2.69869%. The optimum condition was at 1% gelatin concentration, 80^{o}C heating temperature and 10 days storage. According to Lehringer (1982), protein is a macronutrient that plays an important role in the formation of biomolecules and energy sources. Protein is also a source of amino acids that contain the elements C, H, O, and N, which are not owned by fats or carbohydrates.

The use of gelatin in jelly candy, where gelatin is a high molecular weight polypeptide that is soluble in water. Gelatin is often used as a thickener, gelling agent or stabilizer, providing texture and water-holding properties in foodstuffs (Gomez et al., 2009).

Fat Content of Soy Milk Jelly Candy

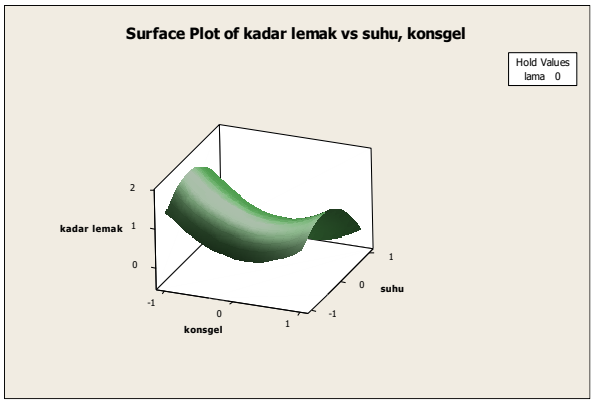


Figure 2. Fat Content of Soy Milk Jelly Candy

The fat content of soymilk jelly candy is 0.409357 - 13.1054%. Soymilk fat content is very low at about 2 grams/100 grams of material. Used gelatin in alkaline conditions which has a fat content of about 0.596 - >3.988%.

In other words, a high concentration of gelatin will produce a low fat content of jelly candy. Fat in a food determines the durability of food ingredients when in storage (deMan, 1989). The low fat content is thought to be the result of raw materials that have low fat content, especially in gelatin. This suggests that gelatin jelly can be used as a low-fat food ingredient.

pH of Soymilk Jelly Candy

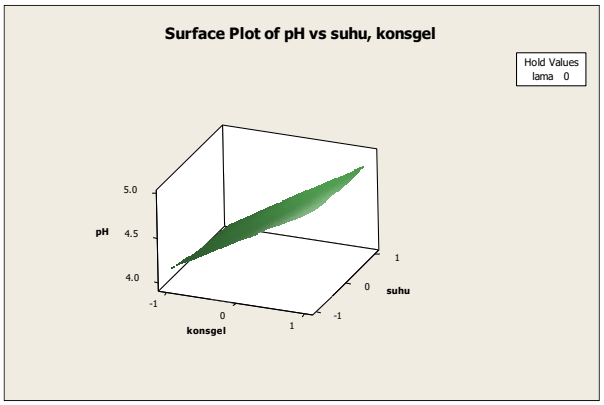


Figure 3. pH of Soy Milk Jelly Candy

The pH of soy milk jelly candy ranges from 3.95 - 5. Soy milk jelly candy is alkaline because it uses catfish gelatin in alkaline conditions / using NaOH. The higher the concentration of catfish gelatin used, the more alkaline it is. The pH of the candy formulation plays an important role in its stability (Shen et al., 2020). According to Moniharapon (2016) said that jelly candy has a medium acidity (pH) level (4.5 - 5.3). According to Muawanah et al., (2012) stated that the acidic pH of jelly candy can be stored for a long time because it can inhibit the growth of spoilage bacteria. In addition, the addition of sugar can also extend storage because sugar can function as a preservative and sweetener.

Moisture Content of Soy Milk Jelly Candy

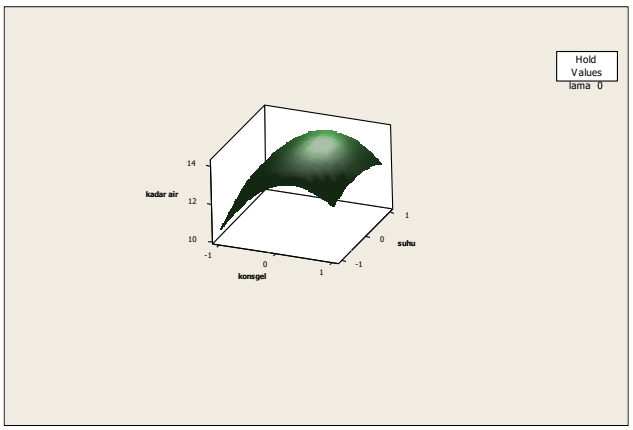


Figure 4. Moisture Content of Soy Milk Jelly Candy

The moisture content of soy milk jelly candy is between 8.8817 - 15. %. Soy milk contains about 90% water, where jelly candy is made by heating. The higher the heating temperature the lower the water content. Based on SNI, the maximum moisture content of candy is 20% (Hidayat and Ikarisztina, 2004). The quality and durability of jelly candy is influenced by water content. How to reduce excessive water content by heating, drying or evaporation. To determine the level of freshness and durability of macnaan, water content testing is required. In addition, moisture content is one of the factors determining the quality of food products such as jelly candy (Herawati, 2008).

Meanwhile, according to Ulfah et al, (2022) that moisture content is an important indicator in food because excessive amounts of water can become a medium for bacteria and fungi that can cause a decrease in the quality and quality of jelly candy. According to Salamah et al. (2006), jelly candy that has low water content is caused by an evenly distributed stirring process so that there is a large evaporation of water. Likewise, according to Sumardiaanto et al. (20119) that the low water content in jelly candy is influenced by the amount of sugar added, where sugar has ossmosiss properties or the ability to absorb water so that the amount of added sugar will affect the moisture content of the resulting product. The moisture content of jelly candy depends on the final product produced and the type of gelling agent used. Although using the same gelling agent, jelly candy that has a high water content will have a softer texture than jelly candy that has a low water content (Ergun et al., 2010).

Reduced Sugar Soy Milk Jelly Candy

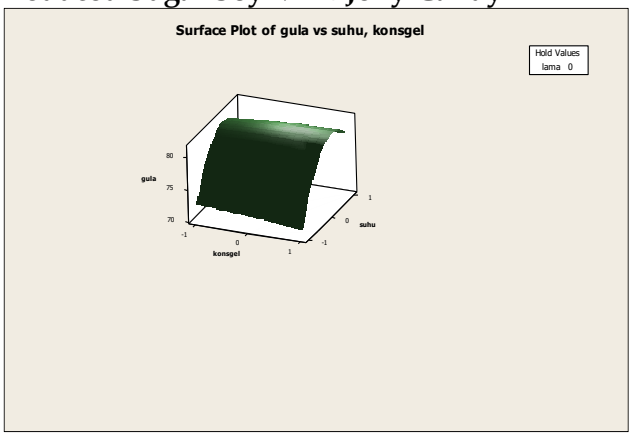


Figure 5. Reduced Sugar Soymilk Jelly Candy

The reduction sugar of soy milk jelly candy is about 44.4897 - 87.7882%. Where the higher the temperature and concentration of catfish gelatin, the higher the reduction sugar. Soy milk that is heated will become simple sugar.

According to Lehninger (1982) that what is said to be reducing sugar is all sugar that has the ability to reduce, where there are free aldehyde and ketone groups. Aldehydes can be oxidized

directly through redox reactions. Monosaccharides that include reducing sugars include glucose, fructose, glyceraldehyde, and galactose. The method of determining the composition of reducing sugars in samples containing carbohydrates used is using the reagent dinitro salicylic acid / 3,5-dinitrosalicylic acid. Meanwhile, according to Santoso (2007) the level of reducing sugar is related to the inversion process of sucrose into invert sugar (glucose and fructose). The inversion process can be influenced by the reaction of acid, heat and mineral content. For acid and heat, the overall reaction is the same, but not for minerals.

CONCLUSION

In this study it can be concluded that soymilk jelly candy with alkaline catfish gelatin process optimal at 1% of alkaline catfish gelatin, 80oC and 10 days storage with chemical characteristics; protein content: 2.331715 - 2.69869%, fat content: 0.409357 - 13.1054%, pH : 3.95 - 5, water content : 8.8817 – 15 %, and reduced sugar: 44.4897 - 87.7882%

REFFERENCE

Abdullah, M., Saleem-ur-Rehman, Zubair, H., Saeed, H. M., Kousar, S., & Shahid, M. (2003). Effect of Skim Milk in Soymilk Blend on the Quality of Ice Cream. Pakistan Journal of Nutrition, 2, 305–311. https://api.semanticscholar.org/CorpusID:85750812

Akesowan, A. (2009). Influence of Soy Protein Isolate on Physical and Sensory Properties of Ice Cream. Thai J. Agric. Sci., 42.

Arbuckle, W. S. (1986). Development of the Ice Cream Industry. In Ice Cream (pp. 1–8). Springer US. https://doi.org/10.1007/978-1-4757-5447-6_1

Badii, F., & Howell, N. K. (2006). Fish gelatin: Structure, gelling properties and interaction with egg albumen proteins. Food Hydrocolloids, 20(5), 630–640. https://doi.org/https://doi.org/10.1016/j.foodhyd.2005.06.006

Cahyaningrum, R., Safira, K. K., Lutfiyah, G. N., Zahra, S. I., & Rahasticha, A. A. (2021). Potensi Gelatin dari Berbagai Sumber dalam Memperbaiki Karakteristik Marshmallow:Review. Pasundan Food Technology Journal. https://api.semanticscholar.org/CorpusID:238790017

Casanova, F., Mohammadifar, M. A., Jahromi, M., Petersen, H. O., Sloth, J. J., Eybye, K. L., Kobbelgaard, S., Jakobsen, G., & Jessen, F. (2020). Physico-chemical, structural and techno-functional properties of gelatin from saithe (Pollachius virens) skin. International Journal of Biological Macromolecules, 156, 918—927. https://doi.org/10.1016/j.ijbiomac.2020.04.047

deMan, J. M. (2007). Principles of Food Chemistry Third Edition. https://api.semanticscholar.org/CorpusID:211249965

Ergun, R., Lietha, R., & Hartel, R. W. (2010). Moisture and Shelf Life in Sugar Confections. Critical Reviews in Food Science and Nutrition, 50, 162–192. https://api.semanticscholar.org/CorpusID:19980997

Gómez-Guillén, M. D. C., Pérez-Mateos, M., Gómez-Estaca, J., Lopez-Caballero, E. J., Giménez, B., & Montero, P. (2009). Fish gelatin: a renewable material for developing active biodegradable films. Trends in Food Science and Technology, 20, 3–16. https://api.semanticscholar.org/CorpusID:59934602

Herawati, H. (2008). Determination of the shelf life of food products. Journal of Agricultural Research and Development, 27(4), 124–130.

Karim, A. A., & Bhat, R. (2009). Fish gelatin: properties, challenges, and prospects as an alternative to mammalian gelatins. Food Hydrocolloids, 23(3), 563–576. https://doi.org/https://doi.org/10.1016/j.foodhyd.2008.07.002

Moniharapon, A. (2016). Chemical and Organoleptic Characteristics of Seaweed Jelly Candy. Jurnal Penelitian Teknologi Industri, 8(2), 91–96.

Muawanah, A., Djajanegara, I., Sa'duddin, A., Sukandra, R. D., & Radiastuti, N. (2012). The use of kecombrang flower (Etlingera elatior) in jelly candy formulation process. Valensi, 2(4), 256–533.

Muñoz-Colmenero, M., Martínez, J. L., Roca, A., & Garcia-Vazquez, E. (2016). Detection of Different DNA Animal Species in Commercial Candy Products. Journal of Food Science, 81(3), T801–T809. https://doi.org/https://doi.org/10.1111/1750-3841.13225

National Standardization Agency. (2008). Indonesian National Standard for Confectionery SNI 3547.2.2008.

Nelson 1942-, D. L. (David L. (2005). Lehninger principles of biochemistry. Fourth edition. New York : W.H. Freeman, 2005. https://search.library.wisc.edu/catalog/999964334502121

Nuh, M., Barus, W., Miranti, M., Yulanda, Y., & Pane, M. (2020). Study of jelly candy making from jackfruit juice. Wahana Inovasi, 9, 93–98.

Salamah, E., Erungan, A. C., & Retnowati, Y. (2006). Utilization of Gracilaria sp in Making Jelly Candy. Buletin Teknologi Hasil Perikanan, 9(1).

Santoso, D. (2007). Utilization of Gelidium sp Seaweed in Making Jelly Candy.

Ulfah, M., Prianto, W., & Prabowo, H. (2022). Study of Water Content on the Shelflife of Vegetable Simplisia Functional drinks wedang rempah . Jurnal Pendidikan Dasar Dan Sosial Humaniora, 1(5).