Packaging design and determination of shelf life Pundang Seluang

Packaging design and determination of shelf life Pundang Seluang

H Harris, N Rochyani and T Widayatsih*

Program Studi Ilmu Perikanan, Fakultas Perikanan, Universitas PGRI Palembang. Jl. A. Yani Lrg. Gotong Royong 9/10 Ulu, Palembang, Indonesia

*helmiharris76@yahoo.com

Abstract. Overall, the processed products of South Sumatera fishery products are more varied, both types and shapes, but to compete at the national level, our processed fishery products are still lagging behind in packaging techniques. This study aims to design packaging Pundang Seluang, resulting in packaging Pundang with a more attractive appearance, practical, hygienic, informative and with a longer shelf life. To get the packaging design, used Try and Error method, while for the determination of shelf life used Accelerated Shelf-life Testing (ASLT) method. The results showed that the Selective Parang packed with primary packaging mix (Polypropylene vacuum plastics) and secondary packaging (labeled carton box) provided more attractive, practical, hygienic, and informative protection with longer shelf life, ie with the mathematical model of the rate of increase Water content k = 0,4529.e 0,322 (1 / T) or with rate of quality degradation k = 0,045% per day. Based on the calculation got the age of save Pundang Seluang Packaging for 113,78 days or 3,792 months.

1. Introduction

Background. In the Banyuasin area, understanding of Pundang is drying fish are small (including fish Seluang) with a little addition of salt and sugar, while for salting and drying of fish that are larger so-called "Balur" (Salted Fish) [1]. Based on the evaluation results from the Office of Marine and Fisheries of South Sumatera [2], the weakness of processed products of South Sumatra fishery products compared to other areas is not good packaging techniques. Although the overall processed products of South Sumatra fishery products more varied, both types and shapes, but to compete at the national level especially abroad, processed products of South Sumatra is still far behind in packaging techniques.

According to Syarief et al. [3] and Haris et al. [4], a good packaging should have seven main functions: 1) Keep food products clean and protect against dirt and other contamination 2) Protect foodstuffs against physical damage, changes in water content and radiation (light), (3) having good function, efficient and economical especially during food placement process into container, 4) having easiness in opening and closing and also having ease in phase handling, transportation and distribution 5) having size, shape and weight in accordance with existing norms and standards, easily disposed of and easily molded or printed, 6) Revealing clear identification, information and appearance in order to assist promotion or marketing, and 7) Environmentally friendly (biodegradable) so as not to pollute the environment. Because Pundang Seluang is one of fisheries processed product from South Sumatera, so there is not much research yet to look at this product. Therefore, the researcher is interested to study more about this Pundang Seluang. Given the many requirements to be met by a packing type, this

research is important to be able to apply better packaging techniques, so that the Selective Pundang generated has a more attractive, practical, handy, hygienic and informative handling function, with shelf life (Shelf life) is longer. Thus it is expected that the attractiveness for buyers will be higher with a wider market reach.

1.1. Problems

From the results of field observations on packaging techniques Pundang Seluang done by the processor is still simple, namely by packaging Pundang Seluang with plastic bags or plastic mica. So this way of packaging gives the impression that Pundang Seluang produced by traditional processing is less prestigious and there is cheap impression. In addition, the shelf life of Pundang Seluang is still short (only about 1 month).

1.2. Research purposes

This research aims to: 1) Produce packaging design Pundang Seluang that can improve packaging function and provide a more attractive appearance, hygienic, practical in handling and informative, 2) Determine how long shelf life Pundang Seluang packed.

2. Methodology of Research

2.1. Time and place

The raw material in this research is Seluang (*Rasbora* spp.) obtained from Home Industry Processing in Sekayu Musi Banyuasin Subdistrict. In addition, the material for the design of packaging, PP plastic, paper box carton, and other supporting materials. While the equipment used is, sealer vacuum, moisture tester, and screen printing equipment.

2.2. Work procedures

Working procedures in this study are as follows: 1) Preparation of raw materials and equipment to be used, 2) Design of packaging design that will be developed with try and error method. There are two forms of packaging that will be developed, the thick plastic PP form of standing pounch labeled as primary packaging and packaging of thick PP vacuum plastic as the primary packaging and packaging labeled carton box as secondary packaging, 3) Graphic design of packaging labels Pundang Seluang in accordance with the Food Law Number 18 of 2013 [5] which contains at least: Product name and trademark, the composition of the packaged material, the net contents, the name and address of the producer producing, the production process, the expiration period, the halal label, 4) Determination of shelf life by Acceleration method, with Water content parameter as a determinant factor of product quality decline.

2.3. Packaging design

To get the design of packaging Pundang Seluang done experiments repeatedly (Try and Error) [6], so get the best packaging design. There are two forms of packaging that will be developed, namely: 1) Primary packaging of thick plastic PP labeled given the form of standing pounch (standing), 2) Primary packaging is a thick plastic PP vacuum combined with labeled carton box as secondary packaging.

2.4. Determination shelf life

Accelerated Shelf-life Testing (ASLT) shelf life expectancy method, that is by storing food products in the environment causing them to be rapidly damaged, either in conditions of higher temperature or humidity of storage space [7]. The data of quality change during storage is changed in the form of a mathematical model, then the shelf life is determined by extrapolating the equations under normal storage conditions. Acceleration method can be done in a shorter time with good accuracy [8,9]. Determination of shelf life using ASLT method, with water content parameter as determinant factor (dominant quality) product quality decline. The study used Randomized Block Design (RBD) which

was arranged by single factor [6], that is temperature variation (T), consisting of 3 treatment levels, namely: T1: Temperature 20 ^{0}C, T2: Room Temperature 30 ^{0}C, and T3: Temperature 40 ^{0}C.

The observations were done every 7 days, consisting of 6 observations, ie observation of the 0th, 7th, 14th, 21st, 28th and 35th day. From the observation of the dominant quality, from the three temperatures at each observation time, a regression analysis is used to obtain the equation of the line. Furthermore, from the three line equations, the data interpolation is a combination of the three line equations to determine the slope rate.

Knowing this slope rate is based on the critical point of shelf life can be determined by the Arhenius formula. The slope rate can be determined by the arhenius formula: In k = A + B x 1 / T if each value of k and 1 / T is plotted in a graph [9,10]. If the model has been obtained, then we can estimate the rate of deterioration of Pundang Seluang at a predetermined temperature.

3. Results and discussion

3.1. Packaging design Pundang Seluang

Results packaging Pundang Seluang already developed is as follows:

- Primary packaging of thick plastic PP labeled given the form of standing pounch (standing) PP labeled plastic packaging formed standing pounch) as shown in Figure 1. Its net content is 500 gr / bag.

Figure 1. PP plastic formed standing pounch.

- Primary packaging is a thick plastic PP vacuum combined with labeled carton box as secondary packaging.

The combined packaging between the primary packaging (PP vacuum Plastic) and the secondary packaging (labeled carton box) can be seen in Figure 2.

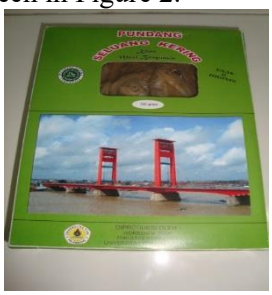

Figure 2. Combined PP vacuum plastic and labeled box.

The design drawing of the front of the label contains pictures of Pundang Seluang with Ampera Bridge, Logo and WSTPHP address of Faculty of Fisheries as producer, net contents 500 gr, Halal label and other information. While the back contains the flow of production process processing Pundang Seluang, as shown in Figure 3.

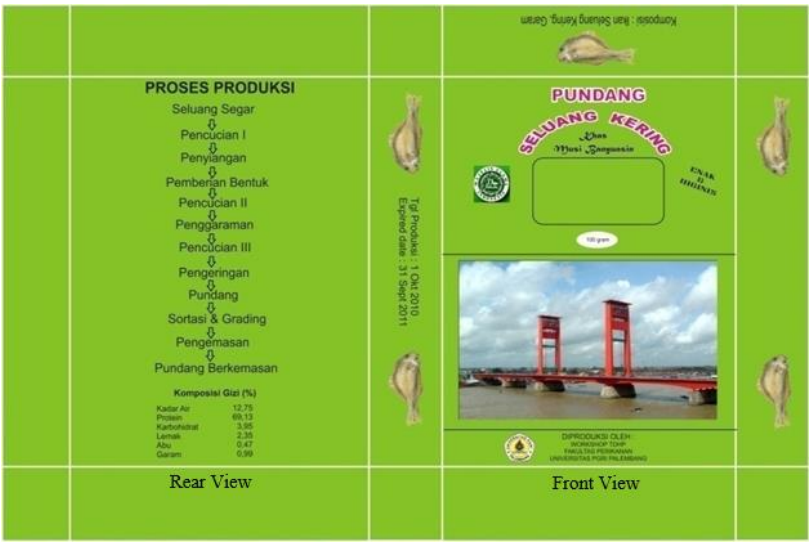

Figure 3. Front and rear label design.

The decorations and labeling used are quite complete as required by the Food Law No. 18 of 2013 which contains: Product name and trademark, composition, net content, name and address of the producer who produces, production process, expiration date, halal label [10]. Currently the University of Fisheries Faculty of Fisheries TPHP Workshop. PGRI Palembang has begun to develop processing technology, packaging techniques and determination of the Pundang shelf life. In the workshop there were also several examples of the Pundang packaging design that had been equipped with important information, in accordance with good packaging principles, as required by the Food Law No. 18 of 2013 [5].

Figure 4. Examples of Pundang packaging developed by TPHP workshop [4].

3.2. Determination of shelf life

3.2.1. Determination of Pundang Seluang critical points. The product used in this analysis is Pundang Seluang. The acceleration method, the damage parameters observed as determining the shelf life of the Pundang Seluang product using water content parameters. In the arrhenius model, temperature is a factor that greatly influences changes in product quality [11].

Preliminary research results that have been carried out on Pundang Seluang to determine the dominant quality critical points Pundang Seluang on sensory testing based on testing conducted at room temperature 30 ° C during 36 days observation and observed every 3 days can be seen that the results of sensory test observations (appearance, mold growth, odor, color and texture) in each observation of the

0th, 3rd, 6th, 9th, 12th, 15th, 18th, 21st, 24th, 27th, 30th, 33rd and 36th day there was a change on 33rd and 36th. This shows that for more or less storage, the time left on 30 days and above has been damaged both from sightings, mold growth, odor, color and texture.

Preliminary research at the invite quality point was carried out samples on the 0th and 33rd day. Pundang seluang samples were analyzed sensorically and the levels. The results of the analysis data are as follows:

Table 1. Pundang Seluang quality critical points.

Day	Sensory	Moisture Content %
0th	Growth of negative mold (-), the smell of dry dried fish, shiny clear color, and elastic texture	11,70
33rd	The growth of positive mold (+), the smell is rancid, the brown color is opaque and the texture is wet soft	16,80

The Pundang seluang analysis as stated in Table 1 above shows that the quality of Pundang Seluang on day 0 is sensory still good while Pundang is still damaged on the 33rd day. The Pundang Seluang quality sensory test refers to the sensory quality criteria used by Liuhartana and Harris [12].

The water content of Pundang seluang on day 0 observations (initial moisture content) was 11.70%, while the Pundang seluang water content that had been damaged on day 33 was 16.82%. Increased water content in some processed foods can be an indication of quality degradation. Increased water content through absorption of water vapor from the environment causes the food product to decline in quality. The quality reduction can mean that food products have reached their shelf life because they have exceeded the critical limit of their water content. The water content in food affects the growth of microbes, including spoilage microbes and pathogens, so that food has a different level of food safety risk. Food with a greater water content is generally easier to grow with microbes so that it is more risky in terms of food security [13].

3.2.2. Determination of shelf life. The parameters observed were the dominant quality of Pundang Seluang which was an observation of moisture content and TPC observation as supporting data.

a. Compilation of dominant quality observation data

Recapitulation of the results of the main research conducted in September - October 2013 against Pundang seluang with three different room temperatures of 20 ° C (T1), 30 ° C (T2) and 40 ° C (T3) for 35 days of storage based on testing conducted at the Integrated Laboratory of the Faculty of Agriculture, Bogor Agricultural University.

The graph of the average linear regression equation of Pundang Seluang water content on vacuum packaging with each temperature can be seen in Figure 5.

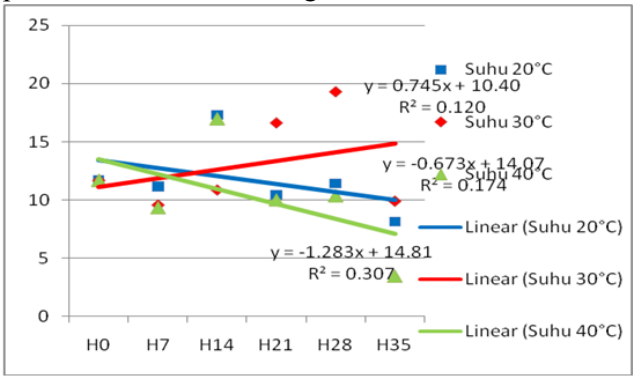

Figure 5. The value of the average linear regression equation for Pundang water content in vacuum packaging with each temperature.

Linear regression curve equation, as follows:

temperature20°C: y = 14,07 – 0,673	r = 0,174	k_1= - 0,673
temperature30°C: y = 10,40 – 0,745	r = 0,120	k_2= - 0,745
temperature40°C: y = 14,81 – 1,283	r = 0,307	k_3 = - 1,283

Determine k and T values Impairment constant value (k):
k_1 = - 0,673
k_2 = - 0,745
k_3 = -1,283

Absolute temperature value (T) (C + 273), namely:
T_1 (20°C) = 290°K_{elvin}
T_2 (30°C) = 303°K_{elvin}
T_3 (40°C) = 313°K_{elvin}

b. Drawing Plotting Value ln and 1 / T
Value of quality reduction (k):
ln k_1 = ln -0,673 = -0,40
ln k_2 = ln -0,745 = -0,29
ln k_3 = ln -1,283 = 0,25

value 1/T :
T_1 = 1/(T) = 34,11 x10^{-4}
T_2= 1/(T) = 33,00 x10^{-4}
T_3 = 1/(T) = 32,00 x10^{-4}

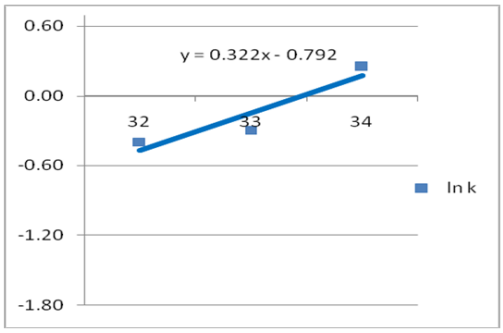

Figure 6. Plot graph of k k and 1 / T values.

Determination of Mathematical Models
The value of k is applied in the arhenius formula, namely:
$k=ko.e^{-E/RT}$
or ln k = ln k_0 – E/RT
because ln k0 = A and -E / R = B is a constant number, the equation can be written as ln k = A + B.1 / T. Calculation of Graph Equations the relationship between storage temperature (0K) and ln at storage temperature is:
ln k = -0,792 + 0,322 (1 / T)

Activation energy value (E):
-E/R = B
-E/R = 0.322 ° K
R = Gas Constant, 1.986 cal / mol
So, E = 0.639492 kal / mol

Constant values do not depend on temperature (k0):
ln k0 = A
ln k0 = - 0,792
k0 = 0.4529380128
so, the value of k0 = 0.4529

Based on the results of the measurement of the average daily temperature at the research location is 30 0C, then to determine the rate of increase in water content in this study used a daily temperature of 30° C.

k $= k_0.e^{-E/RT}$
$= 0{,}4529.e^{0{,}322\ (1/T)}$
$= 0{,}4529.e^{0{,}1322\ (1/273+30}$
$= 0{,}4529.e^{0{,}00106}$
$= 0{,}4529 \times 1{,}00106$
K $= 0{,}4533$

So the rate of decline in quality of Pundang seluang is based on changes in water content = 0.4533% per day.

c. Calculation of shelf life

Based on the results of preliminary research that the critical value of water content from the occurrence of Pundang seluang damage is 5.12%, while the rate of decline in quality is 0.4533% per day = 0.045 then the shelf life of Pundang seluang based on the dominant quality of water content is:

$$\text{Shelf Life} = \frac{\text{Water level critical point}}{\text{Decreasing Quality}} \times 1 \text{ day} = \frac{5{,}12}{0{,}045}$$

$$= 113{,}8 \text{ day or } 3{,}79 \text{ mounths}$$

The rate of increase in water content in Pundang Seluang which is vacuum packed is 0.4533% per day. Pundang Seluang's shelf life which is packed with vacuum is 3.792 months. The results of Curran (1984) research in Syarief and Halid [14] showed that dried fish with lower moisture content (15%) had a longer shelf life (more than one year) than dry fish with a higher water content (20 % - 55%, shelf life three weeks to less than half a week). Kusnandar [13] suggested that water content has an important role in the food system, namely: (1) influencing the freshness, stability and durability of food, (2) acting as a universal solvent for ionic and polar compounds, such as salt, vitamins, sugar and pigments, (3) play a role in chemical reactions (eg polymerization reactions in the formation of carbohydrates, proteins and fats), (4) affect enzyme activity, (5) important factors for microbial growth, (6) determine the level of food safety risk and (7) as a medium to move the level of water safety risk in the food system.

The results of the preliminary study with a room temperature of 30 0C showed that less than 33 days of Pundang seluang had suffered damage from sightings, mold growth, odor, color and texture, while compared to storage research using vacuum packaging, shelf life is 113, 77 days. This is in accordance with the research of Harris and Liuhartana [15] which states that vacuum packaging is more effective in reducing the rate of increase in water content during storage because in the vacuum treatment all moisture and air in the packaging has been sucked out of the packaging first. The rate of increase of water content in the perishable food product can be inhibited by biodegradable and coating film [16].

4. Conclusion

From the results of the previous discussion can be concluded as follows: 1) The packaging design produced can improve the appearance of Pundang Seluang packaging which is more attractive, practical, hygienic, and informative, 2) Based on visual observation (sensory test) of Pundang seluang during 36 days of observation at room temperature of 30 0C, damage occurred on observations on day 33, 3) The

mathematical model of the rate of increase in water content in vacuum packaging is k = 0.4529.e0.332 (1/T) with a rate of decline in k quality = 0.045% per day, with a shelf life of 113.78 days or 3.792 months.

References

[1] Infokito 2007 *Produk Industri Muba Dipatenkan* (Online) available at: http://infokito.wordpress.com 7 August 2018
[2] Dinas Kelautan dan Perikanan Provinsi Sumatera Selatan Bidang Bina Usaha 2015 *Buku Tahunan Statistik Perikanan Budidaya Tahun 2014* (Palembang: Dinas Kelautan dan Perikanan Provinsi Sumatera Selatan)
[3] Syarief R, Halid H and S Syantausa 1991 *Teknologi Penyimpanan Pangan* (Bogor: Arcan bekerjasama dengan PAU Pangan dan Gizi IPB Bogor)
[4] Harris H, R Liuhartana, F Muliajaya and E Robiyardi 2012 *Perbaikan Teknologi Proses Pengolahan Untuk Meningkatkan Mutu Seluang Kering (Pundang) Sebagai Produk Unggulan Khas Sumatera Selatan* (Palembang: Fakultas Perikanan Universitas PGRI Palembang)
[5] Anonymous 2013 *Undang-undang Nomor 18 tahun 2013 Tentang Pangan* (Jakarta: Lembaran Nagara Republik Indonesia)
[6] Gomez K A and A A Gomez 1995 *Prosedur Statistik Untuk Penelitian Pertanian* (Jakarta: Indonesia University Press)
[7] Labuza T P and M K Schmidl 1985 Accelerated shelf life testing of foods *Food Technol* **39**(9): 57−62
[8] Arpah 2001 *Penentuan Kedaluwarsa Produk Pangan* (Bogor: Program Studi Ilmu Pangan, Institut Pertanian Bogor)
[9] Heiss R and E Eichner 1971 Moisture content and shelf life *Food Manufacture* **46**(6): 37−42
[10] Harris H and R Syarief 2012 *Pengantar Teknologi Kemasan* (Palembang: Universitas PGRI Palembang)
[11] Labuza T P 1982 *Open Shelf Life Dating of Foods* (West Port CT: Food and Nutrition Press)
[12] Liuhartana R and H Harris 2011 IdentifikasiTeknologi Proses Pengolahan dan Analisa Mutu Seluang Kering (pundang) pada Pengolahan secara Tradisional *Jurnal Ilmu Perikanan dan Budidaya Perairan* **6** (1): 41-54
[13] Kusnandar F 2010 *Kimia pangan Komponen Makro* (Jakarta: Dian Rakyat)
[14] Syarief R and Halid Y 1993 *Teknologi Pengemasan Pangan* (Jakarta: Arcan)
[15] Haris H dan R Liuhartana 2012 Disain Kemasan Untuk Meningkatkan Fungsi dan Tampilan Seluang Kering (Pundang) *Jurnal Ilmu Perikanan dan Budidaya Perairan* **6** (1) : 27-40
[16] Guilbert S, Gontard N and L G M Gorris 1996 Prolongation of the Shelf-life of Perishable Food Products using Biodegradable Films and Coatings *Lebensm.-Wiss. u.-Technol.* **29** 10–17