Sensory Quality Analysis (Texture) And Moisture Content to Predict the Shelf Life Of Bakpia Filled Seaweed (*Eucheuma cottonii*)

ABSTRACT

Aims: Bakpia is a snack made from a mixture of mung beans and sugar wrapped in pastry and baked. Bakpia is a popular light snack consumed by the Indonesian community. This research aims to determine the shelf life of seaweed-filled bakpia and regular bakpia using the Accelerated Shelf Life Test (ASLT) method

Place and duration: The study was conducted at the Chemistry Laboratory of Pangkep State Polytechnic of Agriculture and the Chemistry Laboratory of Makassar Ministry of Labaoratory Industry from February to May 2023

Study design : The research design involved using the ASLT method to analyze the minimum quality limit at which the bakpia cookies product starts to be rejected by consumers. Samples of the product were obtained from a local mini-market that sells bakpia. The parameters observed were the initial and final moisture content during storage at 15°C, 30°C, and 45°C, as well as the texture before and after the bakpia cookies product was rejected by consumers.

Results : Estimating the shelf life of seaweed bakpia tausa and bakpia tausa using the ASLT method can use a degradation reaction approach (absorption of water content) as a critical parameter. The kinetic reactions of degradation (absorption of water content) of seaweed bakpia tausa and bakpia tausa follow the first order reaction. The shelf life of seaweed bakpia tausa and bakpia tausa uses the ASLT method through a different approach to the critical parameter of water content for each product. At storage temperatures between 15°C and 45°C, the shelf life of bakpia tausa is longer than that of seaweed bakpia tausa. The average shelf life of seaweed bakpia tausar at 30°C is 59.5 days while bakpia lausa is 64.8 days (more than two months).

Conclutions :

The shelf life of seaweed bakpia tausa and bakpia tausa uses the ASLT method through a different approach to the critical parameter of water content for each product. At storage temperatures between 15°C and 45°C, the shelf life of bakpia tausa is longer than that of seaweed bakpia tausa. The average shelf life of seaweed bakpia tausar at 30°C is 59.5 days while bakpia lausa is 64.8 days (more than two months).

Keyword: *ASLT (Accelerated Shelf Life), Bakpia, Eucheuma cottonii, Seaweed-filled*

1. INTRODUCTION

Pia cake or bakpia is a popular snack easily found in several cities in Indonesia, such as Yogyakarta, Jakarta, Denpasar, Gorontalo, and others. Original bakpia (without preservatives) is usually homemade for family consumption and typically lasts for only 2 days (the critical point for microbial colony growth). However, in retail stores (mini markets) that sell bakpia, the product can last for more than 3 months. These commercial bakpia use food preservatives as additives. Bakpia is beloved for its delicious taste and rich texture. When packed in plastic or polystyrene packaging and stored in a humid environment (below room temperature), both below room temperature and at slightly above room temperature, the bakpia stored in the humid condition will show changes in texture (become brittle). Bakpia can be filled with mung bean (known as "tausa") and can be varied with the addition of seaweed (bakpia tausa rumput laut).

Seaweed is a part of aquatic plants (algae) classified into the class of macroalgae, which produces hydrocolloid substances. Besides its agar content, seaweed also contains carrageenan, which has a wider range of applications. The species Gracilaria and Gelidium are primarily used for agar production, while the species Eucheuma cottonii and Eucheuma spinosum are commonly cultivated for carrageenan content. The main composition of seaweed that can be used as food ingredients consists of carbohydrates, ash, dietary fiber, and small amounts of fat and protein. Research conducted by Chaidir (2007) showed that the carbohydrate content of Eucheuma cottonii seaweed soaked in freshwater for 9 hours was 75.36% dry basis (db), ash 18% db, fat 3.39% db, protein 0.43% db, and total dietary fiber 9.62% on a dry basis (db). In food products, seaweed is often used as a beneficial alternative ingredient that can enhance nutritional value.

To accelerate the determination of shelf life, the Accelerated Shelf Life Testing (ASLT) method or acceleration method is used. In this method, storage conditions are set outside the normal conditions, allowing the product to deteriorate more rapidly and the shelf life to be determined (Arpah and Syarief, 2000).

2. MATERIAL AND METHODS

2.1 MATERIAL

The main ingredients used in this study are Green beans (Tausa), Green beans+ Eucheuma cottoni (Tausa + Seawead) , wheat flour, cooking oil and butter, Bakpia from the mini market for samples, Mica or polystyrene packaging. The tools used for Bakpia analysis include Oven, blender, desiccator, spoon, cup porcelain, tweezers and analytical balances, Basins, blenders, pans, spatulas, stoves, scales, thermometers and ovens

2.2 METHOD

This research went through several systematic stages, namely making green bean tausa with the addition of seaweed including the process of soaking seaweed and mung beans which aims to remove the odor the taste and soaking of the green bean seeds aims to make the next process easier. And the other stages are making bakpia skin dough, roasting and proximate analysis.

There are two types of Bakpia products under investigation regarding their shelf life: Bakpia Tausa (mung bean filling) and Bakpia Tausa Seaweed (mung bean and seaweed filling). Each Bakpia product is produced in a quantity of 100 pieces. Storage is conducted at three different temperatures: 15, 30, and 45 °C. For sensory analysis of texture and moisture content analysis (over a period of one month), 15 samples are taken for each temperature of storage. Observations during storage are conducted on the initial storage day, day 0, and subsequently every two days for one month. Consequently, a total of 30 samples are obtained for sensory analysis and 30 samples for proximate analysis (moisture content). Each observation is performed on two samples (2 replicates) for each storage temperature. Critical texture parameters (organoleptic) and moisture content (proximate) are observed.

The initial analysis begins with the sampling of freshly arrived Bakpia Tausa from the store (mini-market) on the first day. The moisture content is then analyzed. Subsequently, samples of broken (non-intact) Bakpia that have been stored for 3 months in the store (mini-market) are taken. This analysis aims to establish a standard linear graph. Once the regression graph is determined, household-scale Bakpia is produced. The Bakpia varieties produced are Bakpia Tausa and Bakpia Tausa Rumput Laut (with the addition of Eucheuma cottonii). These Bakpia products are preserved using food additives. Analysis is conducted over the course of one month, and a regression graph is created. Please note that "bakpia" is a traditional Indonesian pastry, and "rumput laut" means seaweed.

2.3 RESEARCH DESIGN

Research design using ASLT by detemining the minimum guality limit. The minimum guality limit is the quality value at which the product begins to be rejected by consumers (Hough et al., 2006).For the Arrhenius Approach the k value is plotted against 1/T (k-1) and ln k. The intercept and slope values are obtained from the linear regression equation $\ln k = \ln k_0 - (E/R)(1/T)$. where $\ln k_0$ = intercept. E/R = slope. E = activation energy and R = ideal gas constant = 1.096 cal/mol oK. Next the ln k value at each storage temperature is plotted with 1/T.The shelf life of bakpia tausa and bakpia tausa filled with seaweed isi estimated by calculating the difference between the initial score of the product is not liked divided by the rate of quality decline (k) at the temperature which is expressed through the following equation :

The shelf life of bakpia tausa and bakpia tausa filled with seaweed isi estimated by calculating the difference between the initial score of the product is not liked divided by the rate of quality decline (k) at the temperature which is expressed through the following equation :

ts = {(ln(No-Nt)/Kɤ} for first order reaction rates
ts ts = (N0 - Nt)/Kɤ) for a zero order reaction rates
Where :
ts = storaga time
No= quality parameter values at t0 (start of storage)
Nt = quality parameter value after storage time t (critical limit)
Kɤ = k value at storage temperature T

3. RESULT AND DISCUSSIONS

The results of the initial research on the water content of Bakpia Tausa and Bakpia Tausa Seaweed found seen on Tabe! 1 following:

Table 1. Initial water content values of bakpia tausa and seaweed bakpia tausa at temperature 30°C.

Bakpia	Water Content(%)		Texture	
	1	2	3	4
Bakpia Tausa	14,7	22,05	Intact	Completely (No Destroyed)
Bakpia (Seawed)	14,28	21,42	Intact	Completely (No Destroyed)

Meanwhile, the slope, intercept and determination values for order 0 and order 1 reactions increase the water content of bakpia tausa and seaweed bakpia tausa during storage, can be seen in table 2.

Table 2 : Slope value, intercept and determination of order 0 and order 1 reactions water content of bakpia tausa and seaweed bakpia tausa during storage upgrade

Bakpia	T	Ordo 0			Ordo 1		
		Kemiringan	Intersep	Determinasi	Kemiringan	Intersep	Determinasi
Bakpia Tausa	15°C	0,235	14,7	69,6	0,0214	2,73	75,4
	30°C	0,234	14,5	69,2	0,0217	2,71	74,2
	45°C	0,232	14,3	64,2	0,0222	2,69	69,4
Bakpia Tausa Rumput Laut	15°C	0,239	14,28	71,9	0,0219	2,79	72,8
	30°C	0,227	14,20	70,7	0,0225	2,74	73,2
	45°C	0,195	13,5	74,1	0,0233	2,72	79,1

For the Arrhenius equation, the quality reduction (absorption of water content) of the two bakpia products at various storage temperatures can be seen in table 3.

Table 3 : Arrhenius Equation of Deterioration in Quality (Absorption of Moisture Content) of Both Bakpia Products at Various Storage Temperatures

Bakpia	T(°C)	K	ln K	T(°K)	I/ T(°K)	Pers Arrhenius
Tausa	15	0,0214	-3.84	0,0034	Y-3,976+150x	Ln-3,976+150(1/T)
	30	0,0217	-3.83	0,0033	R-0,964	
	45	0.0222	-3,81	0,0032		
Tausa (Seawed)	15	0,0219	-3,82	0,0034	Y-3,972+170x	Ln-3,972+170(1/T)
	30	0,0225	-3,79	0,0033	R-0,994	
	45	0,0233	-3,76	0,0032		

Determination of Critical Points

The water content of bakpia tausa and seaweed bakpia tausa are 14.7 and 14.28 respectively. Estimation of the shelf life of bakpia tausa can be approached by factors of water content (Awasthi et al, 2000; Azisah et al, 2012), microbial and sensory content. Determination of critical parameters used in estimating shelf life is specific for each product. In bakpia products, the critical quality parameter is moisture content which is used as an approach in estimating shelf life.

The initial content of bakpia tausa was 14.7% and that of seaweed bakpia tausa was 14.28% (Table 1). The critical moisture content for cockies is around 28% and above because it indicates that the cookies have absorbed the moisture content and the cookies will become soft and crumble. Storage room temperature for one month if the packaging used is not tight and aseptic then the cookies will be soft and brittle. On the other hand, cookies that are packaged aseptically and tightly closed can last 4 to 7 months. The relationship between Ink and 1/ T in the Arrhenius equation can be seen in the line chart below:

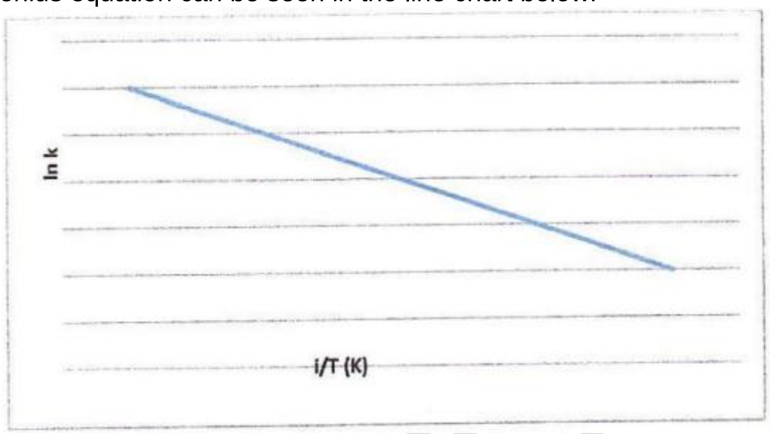

Figure 1. The relationship between In k and 1/ T in the Arrhenius equation.

Estimation of the shelf life of cookies can be approached by three factors, namely microbial content, moisture content and sensory. Determination of critical parameters used in estimating shelf life. The shelf life approach is different for each cookie product according to Afrianti (2008), food preservation by reducing the water content (which is more important is the water activity (aw) has been carried out thousands of years ago. Drying is one of the oldest ways of preserving food. Drying or dehydration is a way to remove or eliminate storage as the X- axis. The selection of the reaction order can be seen by plotting the degradation data according to order zero and order one, then a linear regression equation is made. The reaction order with a larger R2 value is the reaction order used (Arif et al, 2014). Some of the water from a food is by evaporating most of the water contained in the food by using heat energy. Moisture removal at very low levels approaches the "bone dry" condition. Bone dry is a condition where all the water in the material has been removed until the water content of the material is close to zero. Evaporation of water to the point where microorganisms can no longer grow in it. One disadvantage of drying is damage to microorganisms if the initial drying speed is slow or if the moisture content of the final product is too high or if the dry food is stored in a place with high humidity. Afrianti (2008) This theory is used to determine the critical point of cookies if cookies are stored for a certain period of time and cookies absorb water resulting in physical damage (cookies are crushed) and damage to microorganisms.

Determination of the Reaction Order

The speed of quality change for each bakpia parameter is different. If the damage rate occurs in a constant or linear manner, it follows a zero reaction order. However, if the damage rate occurs in a logarithmic or exponentially inconsistent manner, then it follows a first reaction order. Determination of the reaction order is a way to predict quality degradation in estimating the age of foodstuffs following order zero and order one. Zero order can be detected by making a plot between the value of water content as the Y axis and storage time as the X axis. Order one can be detected by making a plot between the In value and the water content on the Y axis and the durationThe determination value (R2) of decreasing water content in the first reaction order is higher than the zero reaction order (Table 4). The first order determination value (R2) for bakpia tausa ranged from 69.475.4, for seaweed bakpia tausa it ranged from 72.8-79. Thus it can be seen that the kinetic reaction of decreasing the quality of the water content of the bakpia (water absorption) follows the first reaction order. A positive slope value indicates an increase in water content in bakpia tausa and seaweed bakpia tausa (Table 2). A positive gradient or slope value indicates an increase in the water content of bakpia (Table 2). The higher the value of determination, the more accurate the results of the data analysis.

Estimation of Shelf Life

When the gradient value is In (natural log) and plotted with I/ T (unit degrees Kelvin) or one absolute temperature, the Arrhnius equation is obtained as shown in Table 3. By calculating the slope of the regression equation between the In value of the moisture content and the testing time at three temperature levels, the value of k or the degradation constant (bakpia water absorption) product is obtained as shown in Table 3.Broadly speaking, the constant value of the degradation rate (k) at each storage temperature can be estimated by the Arrhenius equation obtained. By plotting the inverse of absolute temperature (1/ T) against In k, a graph is obtained as shown in Figure 2. For example, the Arrhenius equation In k-3.976+150(1/ T) (Table 3 and Figure 2) in bakpia tausa is shown the graph is positive, because the longer the bakpia is stored the more it absorbs water, until the moisture content reaches 22.05%, the bakpia starts to become brittle and break apart. The Arrhenius equation is In k -3.976+150(1/ T), then the shelf life of the product if it is stored at 30 °C or 303 °K (room temperature) packed in mica or polystyrene plastic, will produce a value of In k=-3 .48095 or k=0.030778. This means that there will be an increase in water content of 0.030778 units per day. Thus the total quality units until expiration can be calculated by subtracting the critical end value of 22.05 minus the initial quality value of moisture content, namely 14.7, which is 22.055 (half higher than the initial moisture content value) and produces 7.35 quality units. EstimationThe shelf life (ts) of seaweed bakpia can be calculated by the equation ts=[In (No-Nt)]/ KT which is 64.81 days or 2 months more.
Bakpia tausa seaweed has the Arrhenius Ink equation = Y- 3.972+170 (1/ (Table 3 and Figure 2). To estimate the shelf life when the product is stored at 30 °C or 303 "K with plastic mica or polystyrene packaging, it will produces an In value of k-3.41039. or k -0.0330 meaning that there will be a decrease in the quality of bakpia (water absorption) with an increase in water content of 0.0330 units per day. with a critical limit value of 22.45 (half higher than the initial moisture content) and yielded 7.14 quality units (half more higher than the initial quality value (14.28).

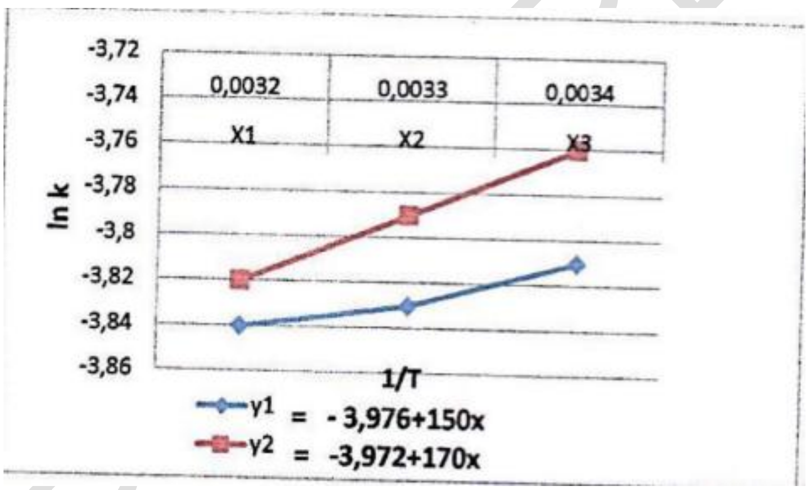

Figure 2: Graph of Relation between Bakpia Tausa and Bakpia Tausa Seaweed Moisture Content and Temperature (1/ T)

Estimated shelf life (ts) of seaweed bakpia can be calculated by the equation t ts- [In (No- Nt)/ KT is 59.56 days or close to two months. From the results of estimating the shelf life using the ASLT method, it can be stated that the shelf life of bakpia tausa tends to be longer than that of seaweed bakpia tausa. The results of estimating the shelf life of seaweed bakpia tausa and bakpia tausa can be seen in Table 4.

Relationship Between Temperature and Shelf Life

Storage temperature is related to shelf life. Temperature affects the speed of damage or absorption of bakpia moisture content. It can be seen on the value (Table 4), the higher the storage temperature the greater the speed of damage/ decreased quality (k) as a result age save (ts) more short Another factor that can influencing the prediction of shelf life is the initial quality value. A high initial quality value can result in a long shelf life. The relationship between storage temperature and the estimated shelf life of several bakpia tausa products is based on The water level absorption approach can be seen in Figure 3.

Table 4 Estimation of Shelf Life of Bakpia Tausa and Bakpia Tausa Seaweed

Temperature	**Self Life (Days)**	
	Bakpia Tausa	**Bakpia Tausa (Seaweed)**
-5	60,75	55,34
0	61,38	55,99

5	61,99	56,62
10	62,58	57,23
15	63,16	57,83
20	63,72	58,42
25	64,27	58,99
30	64,81	59,55
35	65,33	60,09
40	65,84	60,63
45	66,34	61,15

At storage temperatures between 15°C and 45°C, the shelf life of bakpia tausa is longer than that of seaweed bakpia tausa. Bakpia shelf life seaweed tausar at 30°C an average of 59.5 days while bakpia tausa 64.81 days (more than two months).

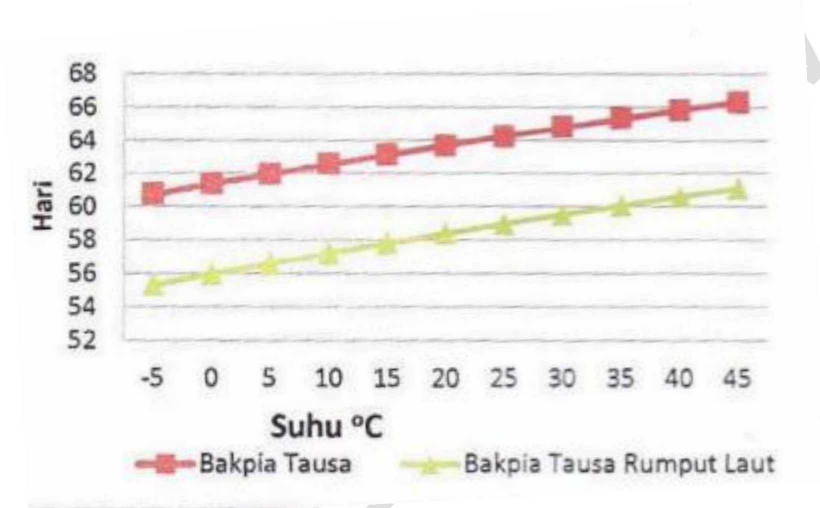

Figure 3. Relationship between storage temperature and estimated shelf life of bakpia tausa and seaweed bakpia tausa on quality degradation (absorption of water content)

4. CONCLUSIONS AND RECOMMENDATIONS

Estimating the shelf life of seaweed bakpia tausa and bakpia tausa using the ASLT method can use a degradation reaction approach (absorption of water content) as a critical parameter. The kinetic reactions of degradation (absorption of water content) of seaweed bakpia tausa and bakpia tausa follow the first order reaction. The shelf life of seaweed bakpia tausa and bakpia tausa uses the ASLT method through a different approach to the critical parameter of water content for each product. At storage temperatures between 15°C and 45°C, the shelf life of bakpia tausa is longer than that of seaweed bakpia tausa. The average shelf life of seaweed bakpia tausar at 30°C is 59.5 days while bakpia lausa is 64.8 days (more than two months).

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