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Determination Shelf Life of Sun-Dried Pork Jerky using the Accelerated Shelf-Life Test Method (Case Study in Debali MSMEs, Kupang City)

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ABSTRAK

Kemasan dendeng yang diproduksi oleh UMKM jarang sekali disertai tanggal kadaluwarsanya. Penentuan umur simpan produk pangan seperti dendeng perlu dilakukan untuk menjamin keamanan pangan. Tujuan dari penelitian ini adalah untuk mengetahui umur simpan dendeng babi yang dijemur produksi Debali dengan menggunakan metode *Accelerated Shelf-Life Testing* berdasarkan persamaan Arrhenius. Dendeng babi yang dijemur yang diproduksi oleh UMKM Debali di Kota Kupang digunakan dalam penelitian ini. Dendeng babi disimpan dalam inkubator selama 30 hari pada tiga suhu yaitu 25 °C, 35 °C, dan 45 °C. Setiap lima hari dilakukan pengujian kualitas organoleptik seperti warna, rasa, bau, tekstur, dan daya terima. Uji organoleptik diikuti 7 panelis. Dengan menggunakan metode ASLT, lama penyimpanan dendeng adalah 30 hari pada suhu 25 °C, 29 hari pada suhu 35 °C, dan 28 hari pada suhu 45 °C. Kesimpulannya, dendeng babi yang dijemur produksi Debali mampu bertahan di suhu ruangan maksimal 30 hari.

Kata kunci : *Accelerated Shelf-Life Testing* (ASLT), Arrhenius, Dendeng babi, Kota Kupang, Umur simpan

INTRODUCTION

East Nusa Tenggara is a province that has the largest number of pigs population in Indonesia. The number of pigs in NTT has continued to increase from 2015 to 2021 (BPS, 2021). Increased pork consumption and demand for processed pork products such as pork se'i, pork buns, pork meatballs, pork tore and pork satay have caused the pig population to increase (Ina *et al*., 2016). In addition, for people of NTT pig is not only play role for economic income but also play a significant role in traditional ceremonies related to culture and religion such as wedding, funeral, birthday, etc (Soja, 2018). Pork is one of the sources of animal protein for the body. Pork is not only rich in nutrients, but also highly preferred for its delicious taste. Currently, Kupang City has many commercial processed pork products such as pork jerky.

Pork jerky is a product of processed pork that is dried traditionally or non-traditionally with a moisture content of 20-40% (Veerman *et al*., 2013). Meat jerky is produced from a combination of curing and drying processes by cutting into thin sheets and then saltpeter, sugar and table salt (NaCl) and spices such as coriander, garlic, shallots, galangal and ginger are added (Bintoro, 2008). The low water content of jerky makes the shelf life of jerky longer.

Debali is a Micro, Small and Medium Enterprise (MSMEs) that produces pork jerky in Kupang City. The packaging for pork jerky produced by Debali is not accompanied by an expiration date. Information regarding expiry dates is important to include on product packaging or labels so that products circulating in the community are guaranteed to be safe and suitable for distribution. According to Law no. 18 of 2012 concerning food producers are required to include an expiry date on the product packaging.

Method that can be used to determine the shelf life of food products is the Accelerated Shelf-Life Testing (ASLT) method. ASLT is a method for determining the shelf life of food products by accelerating the quality reduction reaction by conditioning the food product above normal storage temperatures (Haryati *et al*., 2015; Herawati, 2008). Shelf-life determination needs to be done to ensure food safety. Therefore, the purpose of this study was to determine the shelf life of sun-dried pork jerky produced by Debali MSMEs using the ASLT method.

MATERIALS AND METHODS

The sample used was 3 kg of sun-dried pork jerky produced by MSMEs Debali and stored in an incubator at the Microbiology Laboratory, Medical Study Program, Nusa Cendana University. Sample testing was carried out at the Veterinary Study Program, Nusa Cendana University. The shelf life of pork jerky was determined by the ASLT method using the Arrhenius equation. Pork jerky that has been packaged in a standing pouch (polypropylene) is divided into 3 groups, then stored at 25 ºC, 35 ºC and 45 ºC. The organoleptic testing of pork jerky was carried out every five days for 30 days by 7 panelists from the Veterinary Medicine Study Program. Color, flavour, taste, texture, and acceptability of pork jerky were the organoleptic parameters tested (Table 1).

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Table 1. Organoleptic Test Scores

Score	Color	Flavour	Taste	Texture	Acceptability
1	Grey/black	Rancid smell	Strongly dislike	Very hard/very soft	Soft Strongly dislike
2	Whitish brown/slightly black slight	Slight rancid	Dislikes	Hard/soft Dislikes	Dislikes
3	Slightly brown	No smell	Slightly like	Slightly hard	Slightly like
4	Chocolate	Slightly distinctive smell of jerky	Like	Soft Like	Like
5	Golden brown	Characteristic smell of jerky	Really like it	Very soft	Really like it

The observed data were then plotted against storage time to obtain a linear regression equation y = a + bx (y = product quality value; x = shelf life (days); b = quality change rate; a = initial quality value). Determination of the order of reaction used to calculate the shelf life is to choose the order of reaction that has a greater value of the coefficient of determination (R^2). The next step is to calculate the value of the reaction rate constant (k). The Arrhenius constant is calculated using the following equation: $k = k0.e^{-E/RT}$ (k=reaction rate constant; k0=constant; E=activation energy; R=gas constant (1.986 cal/mol); T=absolute temperature (K)). The shelf life of pork jerky is calculated by the following equation: ts = (No-Nt)/k (ts=shelf life; No=initial quality value; Nt=final quality value; k=reaction rate constant).

RESULTS AND DISCUSSION

In this study, the organoleptic quality of pork jerky including assessment for color, flavour, taste, texture, and acceptability are presented in Table 2. These data show that the average organoleptic quality of pork jerky stored at 25 ºC can be maintained in a fairly good condition up to 30 days of storage compared to storage temperature of 35 ºC which begins to decline at 25 days of storage and storage temperature of 45 ºC which begins to decline at more than 20 days of storage.

Color

The color of good quality pork jerky is usually brown or golden brown. Storage time and storage temperature can cause changes in the color of jerky (Hustiany, 2016). Increasing temperature and storage time changed the color of pork jerky from brown to darker. Jerky stored at 45 °C has the darkest color compared to storage temperatures of 25 °C and

35 °C (Figure 1, Figure 2 and Figure 3). The longer and higher the storage temperature, the darker the product color (Hustiany, 2016). The dark colour of jerky is formed from the Maillard reaction, which is a chemical reaction that occurs when molecules of complex carbohydrates and proteins are broken down due to heating at a certain temperature.

Table 2. Mean Organoleptic Changes in Pork Jerky

Days	Storage Temperature		
	25 °C	35 °C	45 °C
0	5.00	5.00	5.00
5	4.65	4.44	4.13
10	4.41	4.02	3.82
15	4.04	3.51	3.07
20	3.68	3.00	2.38
25	2.87	2.51	1.78
30	2.50	2.17	1.77

Mean organoleptic: 1.00—1.99 = Extremly bad; 2.00—2.49 = Bad; 2.50—2.99 = Moderate; 3.00—3.99 = Good; 4.00—5.00 = Excellent

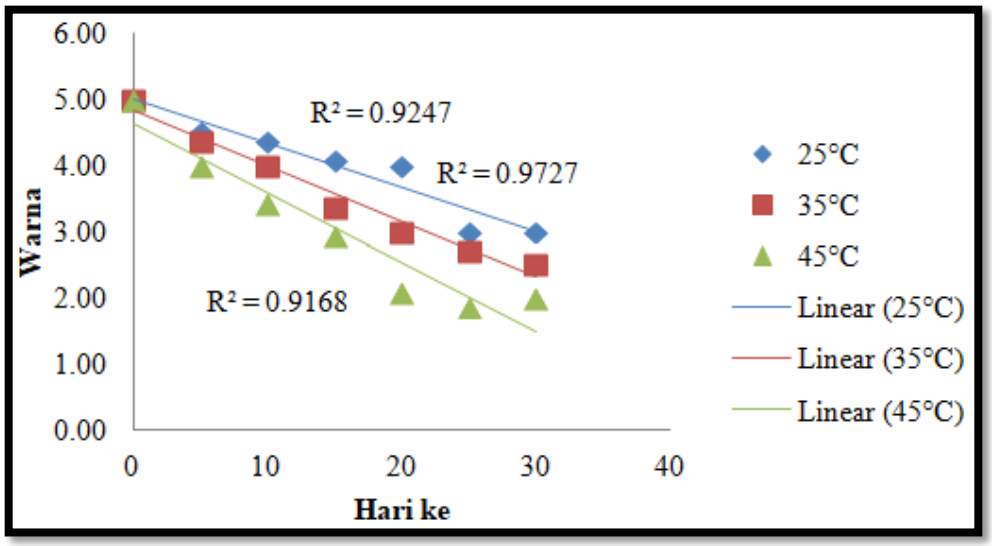

Figure 1. Correlation Between Storage Time and Pork Jerky Color at Different Temperatures

Figure 2. The Color of Jerky on the 10th day at (A) 25 ºC; (B) 35 ºC and (C) 45 ºC.

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Figure 3. The Color of Jerky on the 30th day at (A) 25 ºC; (B) 35 ºC and (C) 45 ºC.

Flavour

Pork jerky has a distinctive flavour of jerky on initial storage (day 0 up to day 15). This distinctive flavour comes from a mixture of sugar, salt and spices (Kemalawaty *et al*., 2019), also the high volatile compounds contained in spices reduce rancidity from meat (Maisyaroh *et al*., 2018). During storage, the flavour of beef jerky decreases and changes from a characteristic flavour to a rancid smell. This may be caused by volatile compounds in spices undergo evaporation during storage due to storage temperature and oxidation of fat in jerky along with the storage period causing changes in the flavour of jerky. Increasing temperature accelerates the process of evaporation of compounds in seasonings (Antara & Wartini, 2014). The process of fat oxidation and hydrolysis reactions cause a rancid odor in beef jerky (Asiah *et al*., 2018). The decrease in the quality of pork jerky flavour has a linear association with storage time and temperature which can be seen in the Figure 4.

Taste

The level of acceptance of jerky flavour is influenced by the spices added during the processing of product. Pork jerky has a distinctive taste, which is sweet, slightly sour and savory, which comes from the addition of sugar, coriander, and other spices. The addition of sugar affects the sweet taste of jerky (Maisyaroh *et al*., 2018). The results of the analysis showed that temperature and storage time had a large influence on the taste of pork jerky. Storage temperature can affect the taste of a food product (Winarno, 2008). The longer and higher the temperature of the beef jerky was stored, the panellist's preference for the taste decreased. This is indicated by the decreasing organoleptic value of taste (Figure 5).

Texture

Pork jerky has a dense and soft texture. The water content of pork jerky is around 20-40%. The layer of fat on the meat fibers makes pork jerky have a slightly more tender texture (Veerman *et al*., 2013). The longer the beef jerky was stored and the higher the storage temperature, the panellist acceptance score decreased (Figure 6). Jerky at high temperature storage has a harder texture, this may be caused by a decrease in water content due to evaporation during storage. The water

content of beef jerky decreases at higher temperatures so that the texture becomes denser and harder (Dariyani *et al*., 2019; Napitupulu, 2012).

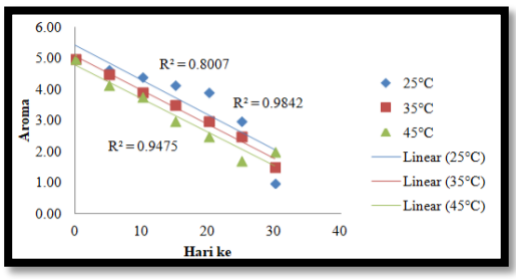

Figure 4. Correlation Between Length of Storage and Flavour of Pork Jerky at Different Temperatures

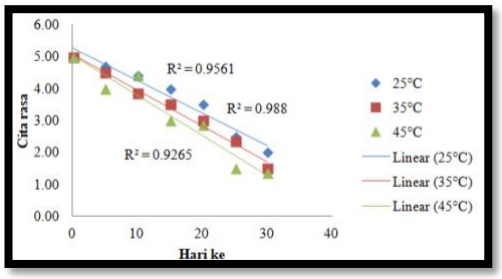

Figure 5. Correlation Between Storage Time and The Taste of Pork Jerky at Different Temperatures

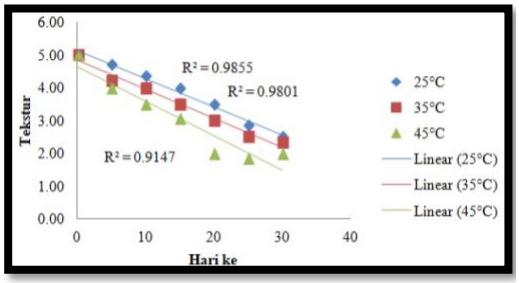

Figure 6. Correlation Between Length of Storage and Texture of Pork Jerky at Different Temperatures

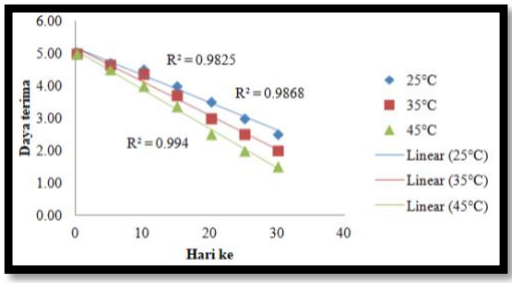

Figure 7. Correlation Between Length of Storage and Acceptability of Pork Jerky at Different Temperatures

Acceptability

The longer the storage, the acceptability of beef jerky decreases (Figure 5). The decrease in the acceptance of beef jerky can be affected by temperature (Asiah *et al*., 2018). Temperature changes the color, flavour, taste, and texture of the beef jerky. The higher the temperature, the darker the color of the beef jerky and the harder the texture. The beef jerky's tough texture makes it hard to chew.

Determination of Reaction Order

The order of reaction used in determining the shelf life of dried pork jerky is order 0 because the coefficient of determination (R2) is greater than order 1. The value of the reaction rate constant (k) shows a decrease in the quality of pork jerky at each storage temperature. The value of k is plotted against temperature based on the Arrhenius equation with slope (–E/R) and intercept (ln k0). The regression equation obtained from plotting ln k and 1/T is y= -1452x + 2.513 (R^2 = 0.9981) -1391.6x + 2.1871 with R^2 = 0.9896.

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Table 3.The Linear Regression Equation and The Coefficient of Determination (R^2)

Temperature		Linear Regression Equations (y = a+bx)		The coefficient of determination (R^2)	
°C	K	Order 0	Order 1	Order 0	Order 1
25	298	-0.0842x + 5.1431	-0.0230x + 1.6745	0.9697	0.9359
35	308	-0.0955x + 4.9551	-0.0281x + 1.6422	0.9976	0.9916
45	318	-0.1130x + 4.8318	-0.0376x + 1.6369	0.9717	0.9718

Table 4. Pork Jerky Shelf Life

Temperature	K Value	Shelf Life
25 °C	0.08353	30 days
35 °C	0.09722	29 days
45 °C	0.11204	28 days

Determination of Shelf Life of Sun-Dried Pork Jerky

Determination of shelf life through the Arrhenius equation at zero order reaction (Table 4). The results of this study indicate that the higher the storage temperature the lower the shelf life of pork jerky. Where the storage temperature of 25 °C has the longest shelf life of 30 days. Storage temperature can affect the shelf life of pork jerky. The higher the temperature, the shorter the shelf life of the beef jerky and conversely the lower the temperature, the longer the shelf life of the beef jerky. An increase in temperature can reduce the quality of pork jerky such as color, flavour, texture, taste and acceptability of pork jerky.

CONCLUSION

Temperature can affect the quality and the shelf life of pork jerky. When there is an increase in storage temperature, the shelf life of pork jerky gets shorter. The lower the storage temperature, the longer the shelf life of the beef jerky. The shelf life of dried pork jerky based on parameters of color, flavour, taste, texture, and acceptability of jerky at a storage temperature of 25 ºC was 30 days, at 35 ºC was 29 days and at 45 ºC was 28 days. Therefore, the recommended shelf life for sun-dried pork jerky products at MSMEs Debali is 30 days at 25 ºC storage temperature.

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