TRANSPUBLIKA INTERNATIONAL RESEARCH
IN EXACT SCIENCES
(TIRES)
VOLUME 1 ISSUE 4 (2022)

THE INFLUENCE OF DIFFERENT DRYING DURATIONS ON THE MOISTURE CONTENT AND PROTEIN CONTENT OF PUMPKIN FLOUR (CUCURBITA MOSCHATA)

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Abstract

Pumpkin (Cucurbita moschata), also known as waluh (banjar) and pumpkin parang (Java), is one of the local foods with high nutritional value beneficial for the human body. Cultivated pumpkin has a shorter shelf life than whole pumpkin, requiring processing into flour to enhance its longevity and prevent damage. This study aimed to determine the effect of different drying times using an oven on protein content and water content in pumpkin flour. The research was conducted at the ULM Banjarmasin Science Laboratory using the Completely Randomized Design (CRD) method with five treatments and three replicates. The flour was produced in the IPA Laboratory of ULM Banjarmasin using various drying time variations with the Completely Randomized Design (CRD) method involving five treatments and three replicates. Parameters assessing the differences in flour included protein content and water content. The test results, analyzed with ANOVA, revealed that the processing of pumpkin flour with different drying times significantly affected the protein and moisture content of the flour. The highest protein content, 24.98%, was found in the T2 treatment involving drying in an oven for 2 hours, while the T5 treatment, drying for 3.5 hours, showed the highest water content at 12.46%.

Keywords: Protein Content, Pumpkin (Cucurbita Moschata), Water Content

1. INTRODUCTION

The yellow pumpkin, scientifically known as *Cucurbita moschata*, is commonly referred to as *waluh* in Banjar and parang pumpkin in Java. This local food ingredient is highly nutritious and offers numerous health benefits. It is packed with beta carotene, vitamin A, fiber, vitamin C, vitamin K, and Niacin or vitamin B3. Additionally, pumpkin is a good source of minerals such as potassium, iron, phosphorus, magnesium, and calcium. Belonging to the Cucurbitaceae family, pumpkins typically ripen quickly. Due to its complete nutritional profile and affordable price, pumpkin has great potential as a local food source. Its main components consist of carbohydrates and water, with carbohydrates making up around 70% of its composition. Given its high carbohydrate content, pumpkin can be processed into flour. Furthermore, pumpkin is also abundant in vitamin A.

Pumpkin offers a unique advantage compared to other food ingredients - it can be stored at room temperature for over six months without significant changes. This characteristic ensures that pumpkin remains readily available to the community. Food processing can help increase the economic value of pumpkin and extend its shelf life. One way to utilize abundant pumpkin harvests is by producing pumpkin flour. Pumpkin plants are widely distributed throughout Indonesia, making them a reliable food source due to their easy planting and maintenance. With each hectare of land capable of producing 20-40 tons of pumpkin fruit, these plants are highly productive. Despite the high availability of pumpkin in Indonesia, its utilization is not yet optimal, even though it can thrive in various locations.

In 2003, data from the Central Bureau of Statistics revealed that the average pumpkin yield in Indonesia ranged from 220-210 tons per hectare. Despite this, pumpkin consumption in Indonesia remains low, at less than 5 kg per capita annually. Given the limited and basic processing of pumpkins, there is a need to convert them into flour for use as an additional ingredient in nutrient-rich biscuit products. Pumpkins are currently underutilized, mainly being used in dishes like vegetables, compote, dodol, walnut chips, walnut sticks, and onde-onde. Therefore, there is a necessity for more extensive processing of pumpkins. Drying and milling the skin into flour is a promising method to prolong the shelf life of pumpkins. The quality of pumpkin flour depends on the preparation method and raw materials used. Due to the high sugar content in pumpkins, a special drying method is required to maintain the nutritional value (Kusuma, 2016).

Pumpkin flour offers several advantages such as a long shelf life, convenient packaging for marketing, and versatility as a raw material for various food products. It can serve as a substitute for wheat flour in the production of different food items. Pumpkin flour is finely ground, passes through a 60 mesh sieve, has a yellowish-white color, a distinct pumpkin aroma, and a moisture content of approximately 13%. The protein in pumpkin flour contains a gluten type protein that aids in forming a cohesive and elastic network, beneficial for volume development in bread and other baked goods. Its gelatinization properties contribute to the quality of recipes by providing consistency, chewiness, viscosity, and elasticity. Proper storage in a plastic container lined with aluminum foil, away from air and light, can extend the shelf life of pumpkin flour up to two months (Putri et al., 2022).

Pumpkin flour possesses unique characteristics and a distinct aroma. It has the potential to complement wheat flour and can be incorporated into various processed food items. These processed products, derived from pumpkin flour, exhibit specific colors and flavors, making them more appealing to consumers. The production of pumpkin flour involves an alternative semi-finished process, which is desirable due to its enhanced storage stability, ease of mixing, shaping, nutrient enrichment, and faster cooking time, aligning with the demands of a practical modern lifestyle. Moreover, compared to starch production, flour production requires less water and is environmentally friendly (Hendrasty, 2003). The drying process plays a crucial role in the production of pumpkin flour. It involves reducing the moisture content of the material to a specific level. The temperature during drying significantly influences the quality of the resulting pumpkin flour. The texture and chemical properties of the flour are influenced by the drying temperature and method employed. Varying drying temperatures yield different outcomes in terms of texture and chemical properties of the final pumpkin flour product (Okulu et al., 2015).

The aims of this research are as follows: 1) To finalize the assessment of the duration of rearing for quails that yield pumpkin eggs with the highest protein content. 2) To finalize the evaluation of the duration of rearing for quails that yield pumpkin eggs with the lowest moisture content. 3) To conclude the impact of various rearing durations on the protein content and moisture content of pumpkin quail eggs.

2. RESEARCH METHOD

The research methodology employed in this study is experimental research utilizing a completely randomized design (RAL). The focus of the research is on pumpkin flour, while the variable under investigation is the impact of different drying times using an oven. Various tools were utilized in the production of pumpkin flour, including knives, cutting boards, containers, sieves, digital scales, stopwatches, gloves, ovens, blenders, jars, baking sheets, scissors, markers, spoons, tongs, and sieves (± 60 mesh). The materials required for the study consisted of yellow pumpkin (*Cucurbita Moschata*), aluminum foil, plastic standing pouches, and ordinary tissue. The process of making pumpkin flour followed the method outlined by Wahyu (2016) and involved several steps such as sorting, peeling, slicing, drying, grinding, sieving, and storage. Data analysis was conducted using SPSS software, with one-way analysis of variance (ANOVA) statistics applied, followed by Duncan's test to identify any significant differences among the treatment groups. The final step involved interpreting the processed data in conjunction with relevant references.

3. RESULT AND DISCUSSION

3.1. Result Research

a. Protein Content Test Results

The report presented here details the protein content analysis of Turmeric Pumpkin Quail Eggs, utilizing research findings derived from the average of multiple measurements conducted. A total of 5 measurements were taken on samples of quail eggs across 3 separate trials. The average data on the protein content of Turmeric Pumpkin Quail Eggs is summarized in Table 1 below.

Table 1. Average Analysis Result of Protein Content of Pumpkin Flour

Sample	Test I	Test II	Test III	Average
P1	24,67	24,55	24,90	24,71 %
P2	25,22	25,00	24,70	24,98 %
P3	24,66	25,10	25,01	24,91 %
P4	24,88	24,65	24,44	24,66 %
P5	23,80	24,00	23,90	23,90 %

Table 1 shows the results of protein content in pumpkin flour with different treatments. Drying using an oven for 1.5 hours (P1) produces a protein content of 24.71%. Drying using an oven for 2 hours (P2) produces protein levels of 24.98%. Drying using an oven for 2.5 hours (P3) produces protein levels of 24.91%. Drying using an oven for 3 hours (P4) produces protein levels of 24.66%. Drying using an oven for 3.5 hours (P5) produces protein levels of 23.90%.

Table 2. Results of One-Way ANOVA Analysis of Protein Content

Protein levels	Sum of Squares	df	Mean Squares	F	sig
Between Groups	2.230	4	.558	13.135	.001
Within Groups	.424	10	.042		
Total	2.655	14			

The results of statistical analysis of pumpkin egg protein content data using SPSS application with one-way ANOVA test showed the value of F = 13.135 and p-value = 0.001 <0.05. These results indicate a significant difference in the average protein content among the five treatments. Based on these findings, the null hypothesis (H0) was rejected, while the alternative hypothesis (H1) was accepted. Therefore, it can be concluded that the length of treatment significantly affects the protein content of Pumpkin (*Cucurbita Moschata*) eggs.

Table 3. Results of Duncan's Further Test for Protein Content

Duncan^2			Subset for alpha = 0,05
Treatment	**N**	**1**	**2**
T1	3	24.7067	
T2	3	24.9733	
T3	3	24.9233	
T4	3	24.6567	
T5	3		23.9000
Sig		.110	1.000

Based on Table 3, it can be concluded that the protein content of T1 is significantly different from the protein content of T5, but not significantly different from the protein content of T2, T3, and T4. T2 protein levels were also significantly different from T5 protein levels, but not significantly different from T1, T3, and T4 protein levels. T3 protein levels were significantly different from T5 protein levels, but not significantly different from T1, T2, and T4 protein levels. T4 protein levels were significantly different from T5 protein levels, but not significantly different from T1, T2, and T3 protein levels. In addition, T5 protein levels were significantly different from T1, T2, T3, and T4 protein levels.

b. Moisture Content Test Results

The average of the water content test results of Telapung Labul Kulning is based on the research results recorded in the average of the existing alignment. Of the 5 experiments, repetition was carried out 3 times. So that the conclusion of data per glance during the Telapung Labul Kulning water content test is written in Table 4 below:

Table 4. Average Analysis Result of Pumpkin Flour Moisture Content

Sample	Test I	Test II	Test III	Average
P1	14,33	14,89	14,04	24,71 %
P2	13,68	13,90	13,72	24,98 %
P3	13,70	13,38	13,56	24,91 %
P4	13,08	13,64	12,98	24,66 %
P5	12,02	12,80	12,55	23,90 %

Table 4 reveal the outcomes of egg moisture content subsequent to undergoing various treatments. The application of heat in an oven for a duration of 1.5 hours (T1) yielded a moisture content of 14.42%. Similarly, heating the eggs in an oven for 2 hours (T2) resulted in a moisture content of 13.77%. Furthermore, subjecting the eggs to an oven for 2.5 hours (T3) led to a moisture content of 13.55%. Moreover, heating the eggs in an oven for 3 hours (T4) produced a moisture content of 13.24%. Lastly, the eggs exposed to an oven for 3.5 hours (T5) exhibited a moisture content of 12.46%.

Table 5. Results of One-way ANOVA Analysis of Water Content

Water Content	Sum of squares	Df	Mean Square	F	sig
Between groups	5.999	4	1.500	12.680	.001
Within groups	1.183	10	.118		
Total	7.181	14			

Table 5 shows the results of statistical analysis of pumpkin egg moisture content data using SPSS application with one-way ANOVA test. These results show an F value of 12.680 and a p-value of 0.001 < 0.05, indicating a significant difference in the average protein content among the five treatments. The ANOVA test results for the moisture content data can be found in Appendix 5.Based on these findings, H0 (null hypothesis) is rejected and H1 (alternative hypothesis) is accepted. This means that the length of dissolving has a significant effect on the moisture content of Pumpkin (Cucurbita Moschata) eggs. Duncan's test results can be seen in Table 6 as follows:

Table 6. Results of Duncan's Further Test for Water Content

Duncan[2]			Subset for alpha = 0,05
Treatment	**N**	**1**	**2**
T1	3	14.4200	
T2	3	13.7667	
T3	3	13.5667	
T4	3	13.5467	
T5	3		12.4567
Sig		.427	1.000

Table 6 shows that the results of the T1 water content test are significantly different from the T5 water content, but not significantly different from the T2, T3, and T4 water content. Water content of T2 is significantly different from water content of T5, but not significantly different from water content of T1, T3, and T4. Water content of T3 was significantly different from water content of T5, but not significantly different from water content of T1, T2, and T4. Water content of T4 was significantly different from water content of T5, but not significantly different from water content of T1, T2, and T3. Water content of T5 was significantly different from water content of T1, T2, T3, and T4.

3.2. Discussion

a. Protein Content of Pumpkin Flour

Based on the data presented in Table 1, it is evident that the T2 treatment, which involved a 2-hour oven treatment, exhibited the highest average protein content at 24.98%. Conversely, the T5 treatment, which underwent a 3.5-hour oven treatment, displayed the lowest protein content at 23.90%. Typically, an extension in the duration of the treatment procedure resulted in a reduction in the protein concentration of the pumpkin egg selbult owing to the process of denaturation. However, it is important to note that the variation in protein content was also influenced by the different types of pumpkins used in the study. Therefore, the protein content of each pumpkin varied during the treatment process. Mardiah et al. (2020) highlighted that the selection of different pumpkin varieties can result in varying protein levels.

The study utilized three different flasks for experimentation, with the first flask allocated for the T1 treatment, the second flask for the T2 and T3 treatments, and the third flask for the T4 and T5 treatments. The second flask demonstrated a decrease in protein levels with increasing treatment duration, as evidenced by the T2 treatment with a 2-hour duration yielding a protein content of 24.98%, which decreased to 24.91% after 2.5 hours of treatment. Similarly, the third flask showed a decline in protein content for the T4 and T5 treatments, with the T4 treatment at 3 hours resulting in a protein content of 24.66%, which decreased to 23.90% after 3.5 hours of treatment.

The duration of treatment has an impact on the protein content of pumpkin, with longer treatment processes leading to a decrease in protein content. Furthermore, the selection of pumpkins for treatment also influences the protein content of each pumpkin due to variations in protein levels. The results of the ANOVA test indicate that the duration of beef heating treatment significantly affects protein content. The Duncan's further test, as shown in Table 3, reveals that treatments with different letter notations have significantly different protein content levels. For instance, if there are 26 notations of the same letter, it implies no significant difference in protein content between treatments such as oven drying for 1.5 hours, 2 hours, 2.5 hours, 3 hours, and 3.5 hours. The data demonstrates that varying the duration of oven baking beef results in distinct protein levels. Changes in protein content can influence protein functional properties, as noted by Estiasih et al. (2013) assertion that protein denaturation can occur through heat, pH, chemicals, mechanics, and other factors. Conversely, this study reveals that higher steaming temperatures and reprocessing fuel through frying can lead to the dissolution of a portion of protein along with water released from the beef. Prolonged drying contributes to protein denaturation, consistent with prior studies (Abdul-Fattah et al., 2007), which highlight that extended drying processes result in increased protein denaturation.

According to Winarno (2002), protein denaturation refers to the alteration of secondary, tertiary, and quaternary structures of proteins without affecting the primary structure, which involves the peptide bond. Denatured proteins exhibit changes in solubility, increased viscosity, and reduced enzyme activity. Various factors can induce protein denaturation, including heat, mechanical treatment, the addition of acids, bases, heavy metals, and salts. Denaturation leads to the exposure of the hydrophobic inner layer of protein molecules, while the hydrophilic outer layer folds inward. The hydrophilic groups bind water, resulting in water entrapment within the tissue. Denatured proteins undergo partial unfolding and breakdown into polypeptide chains, which then interact to form a network. This network absorbs water and, upon heating, can form a gel (gelation). However, gel formation only occurs after some proteins have undergone denaturation. During seed rounding, protein denaturation takes place during the steaming process. Bennion (1980) suggests that proteins are generally sensitive to changes in pH, ion concentration, and temperature. The original structure of proteins relies on weak bonds that are easily disrupted by alterations in pH, ion concentration, and temperature. Denaturation can render the protein more soluble in water. Further heating can exacerbate denaturation, leading to structural damage and protein precipitation.

b. Pumpkin Flour Moisture Content

The implementation of P5 with the environment requires an oven for a duration of 3.5 hours, which accounts for 12.46% of the overall process. On the other hand, the implementation of T1 with a shorter oven time of 1.5 hours results in a higher moisture content of 14.42%. This can be attributed to the fact that higher temperatures lead to a decrease in moisture content. The water content present in the material plays a crucial role in preserving its shelf life. The ANOVA test conducted reveals that different drying times during the processing of pumpkin flour have a significant impact on the moisture content. Consequently, the moisture content in the material evaporates rapidly.

Varying moisture content occurs due to internal and external factors. The internal factor that occurs is the difference in the age of the pumpkin used. The older the pumpkin, the higher the moisture content contained in the egg shells. External factors that influence it include the length of dyeing, dyeing temperature, and the type of dyeing equipment used so that the moisture content produced by the leather gourd is lower. According to the Indonesian National Standard (SNI No. 3751: 2009) on eggs, the quality requirement of moisture content for eggs is a maximum of 14.50%. Therefore, pumpkin eggs have met the Indonesian National Standard because they have a moisture content of 14.42% (P1), 13.77% (P2), 13.55% (P3), 13.24% (P4), and 12.46% (P5). The moisture content of pumpkin eggs with different immersion durations, namely 1.5 hours, 2 hours, 2.5 hours, 3 hours, and 3.5 hours using an oven, showed significant differences. The moisture content with 1.5 hours of immersion was higher than that with 3.5 hours of immersion. The long time allows the cell water contained in the leather flask to evaporate more and more. This is in accordance with the opinion of (Zhai et al., 2021) which states that low water content is influenced by immersion at high temperatures. Winarno (2002) also states that immersion at high temperatures will cause loss of cellular water.

c. Optimal Drying Temperature and Duration

The most effective method for determining protein content in this research was found to be a drying period of 2 hours, yielding superior results compared to drying periods of 1.5 hours, 2.5 hours, 3 hours, and 3.5 hours. This is due to the fact that prolonged drying times lead to increased denaturation of proteins. On the other hand, the optimal approach for measuring moisture content involved a drying period of 3.5 hours, resulting in superior outcomes consistent with drying periods of 1.5 hours, 2 hours, 2.5 hours, and 3 hours. This is because longer drying times lead to greater loss of water content in the culture gourd, ultimately enhancing the quality of the gourd and extending its storage life. In all five treatments, an electric oven set at 600°C was utilized during the drying process. When the temperature was increased to 700-800°C, the proteins in the food underwent structural changes. Although these changes were not extensive, they could potentially lead to increased hardness and loss of moisture in the food product.

The findings indicated that the duration of oven drying had a significant impact on both the protein content and moisture content in the pumpkin cultivation. Decreasing the moisture content enhances the pumpkin's durability and shelf life, while increasing the protein content enhances its nutritional value (Sipayung, 2015). Protein content is a crucial component of food as it serves as a source of energy and plays a vital role in the body's structure and regulation (Winarno, 2002). This study possesses the advantage of yielding optimal outcomes during the experimental process, with the highest protein content and water content measured. However, there are limitations in this study, such as the utilization of a blender as a grinding tool, which fails to achieve a smoother texture for the pumpkin. Furthermore, there was no measurement of protein content and water content conducted prior to the treatment, making it impossible to determine the difference in values before and after the treatment. Additionally, the research involved the use of different types of pumpkins in the experiments.

4. CONCLUSION

The results of the study provide valuable insights into the egg yolk drying process. Upon thorough examination, it is evident that the ideal protein content of 24.98% is reached after 2 hours of drying. Conversely, the lowest water content of 12.46% is achieved after 3.5 hours of drying. These results highlight the complex relationship between drying time and egg yolk composition. Additionally, the ANOVA analysis carried out in the study reveals a significant influence of drying time on both protein and water content, underscoring the necessity of comprehending and managing this variable during the drying process.

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