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Utilization of temperature control technology to improve the quality of Assyifa Black Garlic at the Utsman bin Affan Islamic boarding school

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ABSTRACT

One alternative way to eliminate the distinctive properties of garlic is through processing, namely heat treatment which can improve the taste and create new qualities of garlic without removing the nutritional components of raw garlic, known as black garlic. However, several times there are often obstacles in fulfilling black garlic which can be produced on a large scale, does not require a long time, and is of high quality. Based on the considerations above, research was conducted on using temperature control technology to improve the quality of Asssyifa black garlic at the Utsman bin Affan Islamic boarding school. The equipment used is a thermolysis device with a capacity of 15 kg to 30 kg. This tool has a design similar to a cake-making oven but has a special rack and pan for garlic production. This research uses a survey method by looking directly at the physical characteristics of garlic processed into black garlic. Apart from that, this research also uses organoleptic tests to measure the quality of black garlic in terms of taste on the tongue. The research results, Black garlic Assyifa which is produced using a thermolysis device using the best temperature control is 70°C for 9 days, which has a predominantly sweet taste and a blackish color.

Keywords: *Assyifa Black Garlic, quality,Control, Temperature, Thermolysis*

ABSTRAK

Salah satu cara alternatif yang dilakukan untuk menghilangkan sifat khas bawang putih tersebut adalah melalui pengolahan yaitu dengan perlakuan panas (*heat treatment*) yang mampu meningkatkan rasa dan menciptakan kualitas baru dari bawang putih tanpa menghilangkan komponen zat gizi bawang putih mentah yang dikenal dengan nama *black garlic.* Namun beberapa kali kerap terjadi kendala dalam pemenuhan black garlic yang dapat diproduksi skala besar, tidak memerlukan waktu lama, dan mutunya tinggi. Berdasarkan pertimbangan-pertimbangan diatas maka dilakukan penelitian tentang pemanfaatan teknologi pengontrol suhu untuk peningkatan mutu bawang hitam Asssyifa pondok pesantren utsman bin affan. Peralatan yang digunakan adalah alat termolisis berkapasitas 15 kg sampai 30 kg. Alat ini memiliki desain mirip oven pembuatan kue, namun memiliki rak dan loyang khusus untuk produksi bawang putih. Penelitian ini menggunakan metode survei dengan melihat langsung karakteristik fisik bawang putih yang diolah menjadi bawang hitam, selain itu penelitian ini juga menggunakan tes organoleptik untuk mengukur mutu bawang hitam dari segi rasa lidah. Hasil penelitian, Black garlic assyifa yang diproduksi menggunakan alat termolisis dengan menggunakan pengatur suhu terbaik adalah 70°C selama 9 hari yang memiliki cita rasa dominasi manis dan berwarna kehitaman.

Kata kunci: Assyfa, Black garlic, kualitas, control, temperature, termolisis

1. INTRODUCTION

Garlic (*Allium sativum* L) is a clump of annual herbaceous plants whose lower parts are cloves, joining into large white bulbs. Garlic contains phytochemical compounds. The chemical content of garlic includes 60.3% water, 28.7% carbohydrates, 8.4% protein, 0.1% fat, and GE 138 kcal/100 grams (Sasaki et al., 2007), while

according to USDA (2010) garlic contains 58,000 water. 58%, protein 6.36%, total fat 0.5%, carbohydrates 33.96%, fiber 2.1%, and gross energy 1490 kcal/100 grams. Fresh garlic contains 63% water, 28% carbohydrates (fructans), 2.3% organosulfur compounds, 2% protein (Allinase), 1.2% free amino acids (arginine), and 1.5% fiber (Santhosa et al., 2013). According to Londhe (2011), garlic has 33 sulfur components, several enzymes, 17 amino acids, and many minerals. Garlic has a higher sulfur component compared to other Allium species which results in the appearance of a distinctive odor and various pharmacological or medicinal effects of garlic.

One alternative way to eliminate the distinctive properties of garlic is through processing, namely heat treatment which can improve the taste and create new qualities of garlic without removing the nutritional components of raw garlic, known as black garlic. Black garlic has a black color, is light because the dry matter content is low, and has an aroma and taste that is not too strong (sweet-sour), this is due to the transformation of alliin into allicin as a heat inactivation of alliinase. Black garlic has stronger antibacterial properties so it can inhibit the growth of Gram-positive and Gram-negative bacteria that cause spoilage in processed food products (Saravanan et al., 2010).

According to Wang et al., (2012), black garlic is a heating product of garlic that is heated at a temperature of 70^{o}C with a relative humidity of 70-80% for 30-40 days without any additional treatment. In line with the opinion of Zhang et al., (2015) who stated that in general heating garlic to become black garlic uses a temperature of 60^{o}C-70^{o}C with a heating time of 30 days. If the heating temperature is less than 60oC, the black garlic produced will be of poor quality, with high humidity on the inner surface, whereas, if the heating temperature is more than 70^{o}C, the black garlic will look wrinkled with a burnt appearance, very hard texture, and a bad smell. Stings. During the heating process, the substances contained in fresh garlic will not be damaged because it is wrapped in aluminum foil (Lee et al., 2009).

Efforts to expand the functional properties of garlic have been made, namely by heating at high temperatures and for long periods. This technique can produce black garlic with a mild aroma, sweet taste, and good functional properties. The previous method of heating black garlic was using a Rice Cooker in Warm Mode or a Magic Jar. However, for commercial production, there are problems with temperature regulation and production capacity, so larger equipment needs to be used to be able to produce on a large scale. One of the tools used is a thermolysis tool. Based on the considerations above, research was conducted on using temperature control technology to improve the quality of Assyifa black garlic at the Utsman bin Affan Islamic boarding school.

2. MATERIALS AND METHODS

This research was carried out at the production house of the Utsman bin Affan Islamic boarding school which is located in Jalan Cambodia, Denai Lama Village, Pantai Labu District. This research was carried out in July 2024. The material used in this research was a single medium-size garlic (2 mm diameter) obtained from a garlic supplier in North Sumatra. The equipment used is a thermolysis device with a capacity of 15 kg to 30 kg. This tool has a design similar to a cake-making oven but has a special rack and pan for garlic production. A rack can hold 3 kg of garlic, in this tool, there are 5 and 10 pans so it can produce 15 kg to 30 kg of black garlic (Figure 1). This research uses a survey method by looking directly at the physical characteristics of garlic processed into black garlic. Apart from that, this research also uses organoleptic tests to measure the quality of black garlic in terms of taste on the tongue.

2.1. Step to produce black garlic

The process of making black garlic is as follows, namely.

1. The existing garlic is sorted and selected from those whose skin has been peeled off and is not rotten and is relatively the same size with the aim that when heating it gets even heat, ripening simultaneously.
2. After that, put the garlic in a thermolysis pan and cover it with a cloth so that the heat obtained is homogeneous
3. Cover the baking pan and cover with tape so that it heats evenly
4. Turn on the thermolysis machine at 70^{o}C for 9, 12, and 14 days
5. Every day you need to rotate the pan so that the black garlic produced have an even black color
6. On days 9, 12, and 14, samples were taken to test their morphological and organoleptic characteristics.

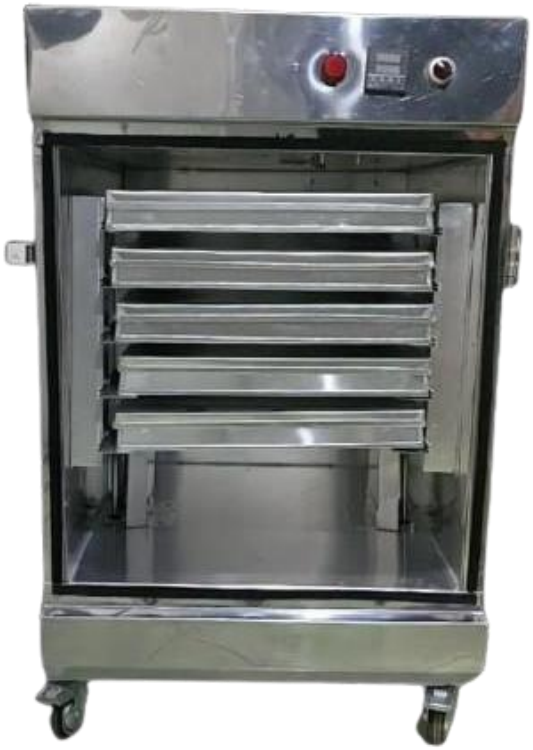

Figure 1. 15kg capacity thermolysis equipment.

3. RESULTS AND DISCUSSION

3.1 Characteristics of Assyifa Black Garlic

The physical characteristics of black garlic obtained in this research can be seen in Table 1. From Table 1 it can be seen that several changes occur in garlic during the heating process. Generally, heating is usually used to improve the quality of food ingredients, the heating process will affect the color, texture, and taste, apart from that it can also increase the content of active compounds in it.

A good black garlic product must meet several criteria, including having a black color, soft texture, sweet taste and not emitting a strong aroma like fresh garlic. The intensity of the brownish color will increase in line with the length of heating time. During the heating process, physicochemical changes will occur such as color, texture, and taste as well as changes in the nutritional content of garlic. When fresh garlic is heated, the texture becomes sticky like jelly, the taste becomes sweet and sour, and the color changes to blackish brown (Bae et al., 2014; Zhang et al., 2015).

Table 1. Results of the characteristics of assyifa black garlic during the processing process using a thermolysis

Time (days)	Physical Characteristics	Observation result
9	Fragrant aroma	Special onions
	Taste	Dominantly sweet, slightly sour
	Shape	Solid
	Colour	Black
12	Fragrant aroma	Typical of reduced onions
	Taste	A bit bitter
	Shape	Dense, dry, brittle skin

	Colour	Deep black
14	Fragrant aroma	Typical of reduced onions
	Taste	Bitter
	Shape	Dense, brittle skin
	Colour	Jet black

Making black garlic in Indonesia is only done by heating garlic for 9 days and can produce black garlic with a soft texture and sweet taste and does not have a strong aroma like fresh garlic, provided that you use a thermolysis tool instead of using other tools such as a rice cooker or oven. Generally. Garlic with a heating time of 12-14 days or more will produce black garlic with a very black color, a slightly bitter taste, even a predominance of bitter color, and a texture that is less soft and even hard because the black garlic will become increasingly shriveled with the longer the heating time.

The advantages of the thermolysis tool used in this research have proven the effectiveness and superiority of this tool in making black garlic when compared to a rice cooker or modified oven. The sharp aroma contained in fresh garlic will disappear after the heating process. Nursten (2005) further explained that color changes due to heat treatment are usually caused by the Maillard reaction, which is known as a non-enzymatic browning reaction. Furthermore, Bae et al., (2014) explained that the heating process can cause non-enzymatic browning reactions such as the Maillard reaction, caramelization, and phenol oxidation, where a number of these reactions are related to the formation of compounds that have strong antioxidant properties.

Heating for a long time can cause damage to carbohydrates, namely the occurrence of non-enzymatic browning reactions (Maillard reactions) and caramelization. The Maillard reaction occurs due to the reaction between the amino groups of proteins and the carboxyl groups of reducing sugars which produces a brown material, while caramelization occurs due to the reaction between sugar and heat. Carbohydrates can improve the taste of black garlic, making it sweet due to the presence of sucrose and a blackish brown color due to the Maillard reaction between sugar and amino acids when heated. Choi et al., (2014) further stated that the sugar content (glucose, fructose, sucrose, and maltose) in black garlic increases compared to fresh garlic. This increase in sugar content is related to the sweet taste of black garlic.

The reducing sugar content in the process of making black onions is influenced by two factors, the first is that the hydrolysis reaction of polysaccharides into reducing sugars will cause the reducing sugar levels to increase. The second factor is the Maillard reaction which causes a decrease in reducing sugar levels (Zhang et al., 2014).

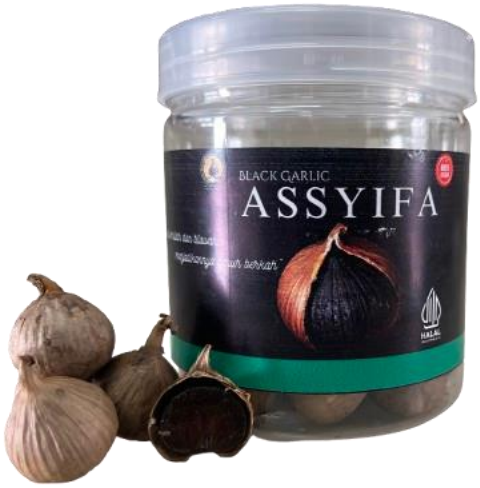

Figure 3. Assyifa black garlic produced by the Utsman Bin Affan Islamic Boarding School

4. CONCLUSIONS

Assyifa black garlic is produced using a thermolysis device using the best temperature control, namely 70^{o}C for 9 days, which has a predominantly sweet taste and a blackish color.

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