2022 Al-Baarri Corn germ

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Corn Germ Color Detection during Storage in Kendal Regency, Central Java

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Abstract
Kendal is in Central Java, Indonesia, and has large production in corn and prominent corn-produced-regency in Indonesia. Two varieties have been cultivated in this regency but no documentation on its appearance in germ color. This research was done to analyze the corn ness, yellowness, mushroom smell, and RH in the corn as a heating process to decrease water content in corn prior to its storage. The research used NK212 and Perkasa 72 corn varieties which were commonly obtained in this local area. The shininess, color appearance, and smell senses of the 25 panelists were used to detect shininess, yellowness, and mildew odor. The obtained data was explained using the relative humidity or RH value as supporting data. The automatic RH meter that was integrated and synchronized in the cloud was used to detect the RH of the corn seed. All samples were placed in the glass box with no additional treatment but was covered using thin cloth to avoid contamination and infection. The corn was stored for 6 months. As result, shininess, yellowness, mildew odor, and RH value provided specific value among these two varieties.

1. Introduction

Corn (*Zea mays ssp. mays*) has a high contribution as a carbohydrate-rich food along with wheat and rice and as a substitute for rice in specific countries including Indonesia [1]. It is known that corn seeds contain a lot of protein as much as 6-12% and an abundance of starch with a concentration of 61-78% (db) makes corn a cheap source of starch [2], furthermore, corn has various mineral elements that are beneficial effect for the body [3]. Corn as an agricultural commodity in Indonesia is very abundant in certain areas including Java and Sumatera. Corn is a type of cereal plant commodity that is widely developed in Indonesia. Many are planted in second place after rice and become the main food in several areas in Indonesia.

In Java, one of the large regencies that is well recognized as corn producing areas is Kendal that is in Central Java. Since the large production in this regency, post-harvest handling is strongly required to keep the high quality of final product. The quality standards on corn are damaged. As corn is exposed to pests and diseases during storage. Produces foul, sour, musty, or other foreign odors. Changing the color of corn seeds and cracked corn seeds. then losing the quantity of corn quantity is inevitable. The fluctuation in the price is also another problem that should be addressed; therefore, corn storage seems to be the most key factor as consideration to solve the post-harvest problem.

The long storage of corn provides a strong effect on the possible loss of quality since temperature and humidity in Kendal are quite fluctuated resulting in the range of temperature starting from 25 to 35˚C and for RH ranging from 69 to 83%. On April to October was detected as hot in temperature as compared to other months. All these reasons made corn quality rapidly decreases. Mold and mycotoxin could infect the corn that made 2% loses nutritional demand values [4] and aflatoxins could make issues here [5] that are dangerous for health and unpleasant smell. It is also affected by the color of corn [6]. Under research of Scariot et al. [7] known that low humidity and stored about of 16–24˚C can obstruct the metabolism of corn seed and the decrease could be reduced. So, it is expected that storage by pre-heating for 40±2˚C can keep quality such as shininess, yellowness, mildew odor, and (relative humidity) RH of corn seed. This research is useful to provide information about post-harvest handling using heating treatment before storage so it can be considered to reduce corn loss and maintain corn quality.

2. Materials and Methods

2.1. Materials

The materials used in this research was Perkasa 72 variety of corn seeds derive from Kendal regency, Central Java. The tool used in this study is a glass box, thin clothe, RH meter.

2.2. Methods

2.2.1. *Corn Preparation*. Corn is harvested directly from plantations in Caruban Village, Ringinarum Subdistrict, Kendal Regency. The choice of corn to be used is to make sure in the corn harvesting process. The harvested corn is ripe at the appropriate age for corn to be harvested. Because if harvesting is done before harvest time, the quality of corn will decrease. Produces young grains that are easily damaged, reduce shelf life, and lose volume. Or vice versa do not exceed the age of corn harvest. because corn will experience nutrient degradation. This decrease in nutrients will increase the risk of *Aspergillus sp*. and make the seeds blackish white with a mildew smell. Preparation samples of Corn kernels were using the method of Entego et al. [8] with modification. Corns were separated using hand manually. Corn shelling serves to separate the corn germs from the cobs. The corn is held in the left hand and the right hand moves to release the corn kernels from the cob, use the thumb to press and push the corn. Then dried using an oven at 40±2˚C until their accomplice moisture content of 14% following the SNI (Indonesian Nasional Standard) 4483:2013 [9]. Hereafter, the corn seed is stored in a transparent glass container and tightly closed. Storage is carried out in a room with a controlled temperature of ±25˚C and a humidity of 50–60% for 6 months. Furthermore, the corn seed was analyzed by shininess, yellowness, and mildew odor using senses by 25 panelists and relative humidity (RH) using the automatic RH meter.

2.2.2. Shiny, Yellowness, and Mildew Odor Analysis. The shininess, yellowness, and mildew odor analysis were observed using the method from Trina et al. [10] with slight modification. Each panelist is given 1 random corn seed in a zipped plastic and asked to rate the shininess of the corn seed every 2 months for 6 months using their sense of sight and sense of smell. For the shiny parameter, a positive sign is given if the observed corn still has a bright color. If the bright color is lost it will be given a negative sign. The yellowness parameter in corn will be given a positive sign if the observed corn still has a yellow color. If the yellow color is gone it will be given a negative sign. The mildew parameter of corn will be given a negative sign if the observed corn does produce an unpleasant odor. If the smell of mold or an unpleasant odor has started, it will be given a positive sign.

2.2.3. Relative Humidity (RH) analysis.Relative Humidity (RH) of the corn seed was analyzed using the method from Oko and Nnamchi [11] by digital thermometers with humidity gauge which is placed in a transparent container and then noted every 2 months for 6 months

3. Results and Discussion

Based on observation of stored corn, can be seen changes in parameter shiny, yellowness, and mildew. A positive sign for shiny and yellowness parameters indicates good corn quality, while a negative sign indicates a declining corn quality. A negative sign for mildew parameters indicates good corn quality, while a positive sign indicates a declining corn quality. For hedonic or organoleptic tests of a product, a numerical score is usually used to indicate the quality of the product. The smallest number is usually categorized as poor quality and the large number is usually in the good quality category. However, for this study, there were only two choices of assessment, namely a positive sign or a negative sign, so that an assessment that seemed dubious could be avoided. Quality assessment with positive and negative signs is also deliberately carried out because it is based on actual field conditions. Usually traders who sell to feed mills will be rejected if the quality is bad and accepted if the quality is good [12]. There is no quality of corn whose value is in the middle, ranging from 45 to 55 percent, which is received by the corn processing factory. For this reason, a positive signs and negative signs will make it easier for producers and consumers of corn in giving an assessment of the quality of corn compared to an assessment through a score.

Table 1. The Color of Corn Germ After heating at 40±2ºC and Relative Humidity (RH) Condition

Sample	Parameter	Month 0				Month 2				Month 4				Month 6			
		Week				Week				Week				Week			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Control	Shiny	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-
Corn Seed		+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-
Control	Yellowness	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-
Corn Seed		+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-
Control	Mildew	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+
Corn Seed		-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+
Control	RH (%)	59	60	63	63	67	56	71	72	73	73	73	75	75	76	76	76
Corn Seed		45	40	45	48	47	43	56	46	47	49	55	50	46	53	58	60

Based on Table 1 shows the corn germ that is given with heating treatment produces corn that has a long shelf life compared to the corn without heating treatment before storage. It is shown from the shiny, yellowness, and mildew parameters. The shiny of corn will be present at the beginning of storage, then disappear or negative sign after two months of storage. The yellowness of corn will decrease and disappear with the passage of storage time. Corn that received oven drying treatment could maintain yellowness longer than control corn. The smell of mold on the corn will appear and get stronger as he length of storage time. Control corn was found to smell mildew faster than corn that was treated with oven heat. Incorrect handling and storage time after harvesting will make the quality of the corn decrease due to moisture content. Moisture content that contained at corn seed could affect the appearance during storage.

The corn germ's control shininess lasts longer rather than the corn with heating treatment. During heating treatment oxidation occurs and change of the trans carotenoid isomer to cis isomer [13]. It is made the shiny decreased, slightly shriveled and brittle. Meanwhile, the other one without heating treatment will have higher water contain and made the corn germ have the shinier, fresher and softer look [14].

The color of heated corn germs tends to have a darker color but has an insignificant color difference when compared to unheated corn germs. The color difference that occurs in heated corn germs is caused by the oxidation process that occurs during the heating process. Entering the fourth month, the control of the corn germ appears to have experienced a yellow discoloration until the last week. This yellow fading is gradually followed by the appearance of white and black. The appearance of white and black color is because the corn germ without heating treatment begins to grow mold. Corn germ with heating treatment still has a yellow corn color that lasts longer compared to corn without pre-heating treatment. This is because the low water content due to heating treatment on corn can make the color more stable than corn germs which have high moisture content [15]. In addition to heat treatment, a good storage area is needed. Storage containers are also an important factor to maintain the quality of corn germs. Keeps corn germs dry and can protect against insect and rat bites.

The yellow discoloration of the corn germ is followed by the appearance of a mildew odor. The germ control corn began to smell mildew in the first week of the fourth month of storage. Meanwhile, the corn germ that was given pre-heating treatment began to smell the mildew odor in the last week of the fourth month. The mildew odor arises because mold starts to grow and contamination when corn germ is stored for a long time [16]. Corn germs after being harvested and not drying have a moisture content of about 35-40% [17]. The moisture content on corn and humidity levels in an uncontrolled environment make microorganisms easy to grow. The high water content in the control corn germ that was not treated with heating and unstable relative humidity (RH) values were during storage from time to time made relative humidity (RH) increase.

Microorganisms that are known to cause damage to corn during storage are *Aspergillus flavus* and *Aspergillus fumigatus* fungi. This fungus is the cause of damage to the appearance and quality of the corn. Such as physical damage, visible mold, discoloration, unpleasant odor, and brightness on corn [18]. *Aspergillus sp*. will produce aflatoxins that are harmful to the health of the body such as cancer [19]. Aflatoxin produced by *Aspergillus Sp*. is categorized as a first-class carcinogen by the International Agency for Research on Cancer [20]. This damage also makes the corn does not have a long shelf life.

Heating treatment could reduce water content at corn seed and prevent the risk of microorganism contamination and effects the corn germ. This is in accordance with the opinion of Zhang et al. [21] heat treatment could inactivate microorganisms due to reduced humidity. Drying is an important method because the moisture content can drop to the appropriate moisture content value. Then, corn seeds can be processed into the next process and are more durable during storage. Corn seed products produced have high product quality. with controlled water content, making the fungus unable to breathe.

The relative humidity (RH) parameter in the control corn germ and corn germ treated with heating showed a fluctuating percentage but it could be seen that it tended to increase with storage time. This is because the storage of corn germ is stored at room temperature which causes different relative humidity (RH). In addition, the permeability of the packaging can affect the value of the percentage relative humidity (RH). Water vapor from container packaging can penetrate the packaging at certain temperature and relative humidity (RH) conditions which will affect the relative humidity (RH) inside the package. Although, the relative humidity (RH) value in corn germ also increased up to 60%, but the relative humidity (RH) value was still within the ideal relative humidity (RH) range for corn seed storage. Because the ideal relative humidity (RH) for storing corn kernels is around 50-60% [22]. It is known that the main factor that needs to be considered in storing corn seeds for a long time is the moisture content of 1-2% below the predetermined moisture content and has a maximum humidity of 60%.

4. Conclusions

Based on this result it can be concluded that the yellowness of corn will decrease and disappear with the passage of storage time. Corn that received oven drying treatment could maintain yellowness longer than control corn. The smell of mold on the corn will appear and get stronger with the length of storage time. Control corn was found to smell mildew faster than corn that was treated with oven heat. The heat treatment can prolong the shelf life of corn germ.

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