Effect of salt addition on self-life of fresh ground chili in Padang City, West Sumatera

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Abstract.
Objective: This study aimed to study the effect of adding salt to the shelf life of fresh ground chili. **Material and method**: Four concentrations of salt (sodium chloride) were added to fresh ground chilies, namely 0%, 6%, 12% and 18%. The treated chilies were stored at ambient condition (temperature ± 28-30 ˚C. To show the quality level of fresh ground chili, several analytical parameters were carried out such as water content, pH, total acidity, color and total number of plates. The analyses were conducted periodically. Based on the results of the analysis, it is known that the value of the analysis of water content, pH, total acid, color and total plate number shows the same pattern. **Results:** It was known that the use of salt with concentrations of 12 and 18% can maintain the freshness of fresh ground chili. The use of salt content from 0 to 6 % was known to not be able to maintain the freshness of fresh ground chilies. **Conclusion:** In this study it can be concluded that the use of salt with a concentration of 12% can be recommended to extend the shelf life of fresh ground chili while 18 % should be the best ones. The optimization of concentrations between 12 and 18% needs further study.
Keywords: chili, puree, salt, storage, quality, preservation

Introduction

Chili (*Capsicum sp*) is an herbaceous plant from the eggplant family (Solanaceae) which has long been known as a cooking spice. Chili is an annual or short-lived plant whose height can reach 1.5 m. Like plants in general, chili has plant parts such as roots, stems, leaves, flowers, fruit, and seeds. Chili has a fairly complete nutritional content so it is widely used for household consumption in the food industry. Chili contains carbohydrates, fat, protein, B vitamins, vitamin C, vitamin E, capsaicin, flavonoids, water, minerals, and dietary fiber. It is also containing compounds that act as antioxidants, including vitamin C, vitamin E, vitamin K, phytosterols, and beta-cryptoxanthin which can protect the body from free radicals. The capsaicin contained in chili peppers can protect the body from cancer. In addition, chili also contains mucokinetic

substances known substances that can regulate, reduce, and remove mucus in the lungs. Therefore, chili is very good for consumption by people who suffer from bronchitis, colds, sinusitis, influenza, and asthma because it plays a good role in spending mucus.

Chili is one of the horticultural products that are prone to damage so they cannot stand being stored for a long time in a fresh state. Chilies are easy to experience quality deterioration due to the high-water content in chilies, causing the transpiration process in chilies to continue after the chili is harvested. This quality deterioration causes chilies to have a short shelf life, which is only about 2-4 days after being harvested. Therefore, it is necessary to process agricultural products as an effort to extend the shelf life of chili.

Along with human life that wants everything to be instant, fresh chili is processed into ground chili so that it is easy to consume or process. However, the shelf life of ground chili peppers is very short and easy to lose taste, increase water content, and experience decay. One alternative that can be used to extend the shelf life of ground chili is to add preservatives when grinding chilies, such as salt (NaCl). Salt can function as a preservative because salt can selectively inhibit the growth of microorganisms (Indriato el at., 2021). In West Sumatra, Indonesia, people have preserved ground chilies using salt (Syukri et al., 2022). The use of this salt is done with various concentrations. There is no clear information about the optimum salt concentration to be used for the preservation of ground chilies. Therefore, in this study, chili was stored at room temperature (25^{o} C) with the addition of different concentrations of salt to determine the optimum salt content that could extend the shelf life of ground chili.

Material and methods

This study was carried out on period of Mei to October 2022. In this study, the raw material used was curly red chili. The fresh chilies were ground using a blender and then treated with the addition of salt. Ground chili was treated with the addition of salt concentrations of 0%, 6%, 12%, and 18%. The ground chilies are then packed in two layers of plastic clips, then packed again using black plastic on the outside. Furthermore, the chilies are stored in the bio incubator with temperature as ± 30 ˚C. Sampling was carried out on storage days 0, 2, 4, 5, 7, and 9. The ground chili was tested for several quality parameter such as pH, water content, total titrated acid, color test, and total plate count number (Azima et al., 2016; Syukri et al., 2018; Syukri et al., 2014; Rini et al., 2021).

Measurement of the pH value was done using a pH meter which was previously calibrated using a buffer of pH 4 and pH 7. The measurement is done by dipping the pH meter electrode in 10 mL of liquid sample and waited until the number on the pH meter is stable.

The method for measuring total titrable acidity involved taking a 10 mL sample, adding three drops of phenolphthalein indicator, and then titrating it with 0.1 N NaOH solution until the color turned pink and remained after homogenization.

By calculating the sample's Hunter L*, a*, and b* values, the color was assessed. White is 100 and black is 0 on the lightness axis (L*). Positive values are represented by red, whereas negative values are represented by green, and 0 is neutral. Positive values are yellow, whereas negative values are blue, and 0 is the neutral value. All measurements were made at 20 °C using a spectrophotometer, a Minolta CM- 2500d reflectance colorimeter.

The estimate of the number of bacterial colonies presents in the sample, with appropriate dilution, is the basis of total plate count (TPC) analysis. To avoid unfavorable contamination, all work is done aseptically, and double observation can boost accuracy. A petri dish with between 30 and 300 bacterial colonies can be used to compute the number of bacterial colonies. Before use, pipettes, Petri plates, and test tubes are sterilized in an oven at 180°C for two hours. The media was autoclaved for 15 minutes at 1 atm pressure and 121 oC to sterilize it. After sterilization, the media are kept warm in a water bath at 45–55 °C to prevent them from freezing. A 8.5 grams of NaCl were dissolved in 1 liter of aquadest, which was then autoclaved at 121 ° C for 15 minutes to sterilize it. This created the diluent solution. To create dilution 10^{-1}, the 10 grams of sample were first crushed, then dissolved in a sterile diluent solution that had been contained in a volume that reached 100 ml. To obtain a 10^{-2} dilution, the solution is pelleted into a volume of 1 ml, which is then injected into a test tube that has 9 ml of a sterile diluent solution. and so forth until dilution 10^{-5} was attained. A 1 ml pipette is used to extract the dilution response from each tube, and it is then placed in a petri plate that has been sterilized. Each dilution is carried out twice. The Plate Count Agar (PCA) media is then distributed uniformly by moving each cup in a circle on the table. Following PCA freezing, the petri dish is incubated for 48 hours at 30°C in the incubator while being held upside down.

Result and Discussion

The results of the pH test can be seen in **Fig 1.** These results indicate that the pH of chilies has decreased during storage. The most rapid decrease in pH occurred in ground chili

with 0% salt treatment or control, were at the beginning of grinding the chili pH was 5.85 and continued to decrease rapidly during storage. The slowest decrease in chili pH occurred in ground chili with 18% salt treatment. The decrease in pH is due to the breakdown of NaCl compounds into their constituent molecules, namely Na^+ and Cl^- ions. Na^+ ions are needed by lactic acid bacteria to support their growth. While the Cl^- ions will bind to free water in the material which causes the availability of water in the material to decrease so that the free water that should be utilized by microorganisms for growth is reduced and causes the environment to become acidic due to the formation of HCL compounds (Yuktika et al., 2017)

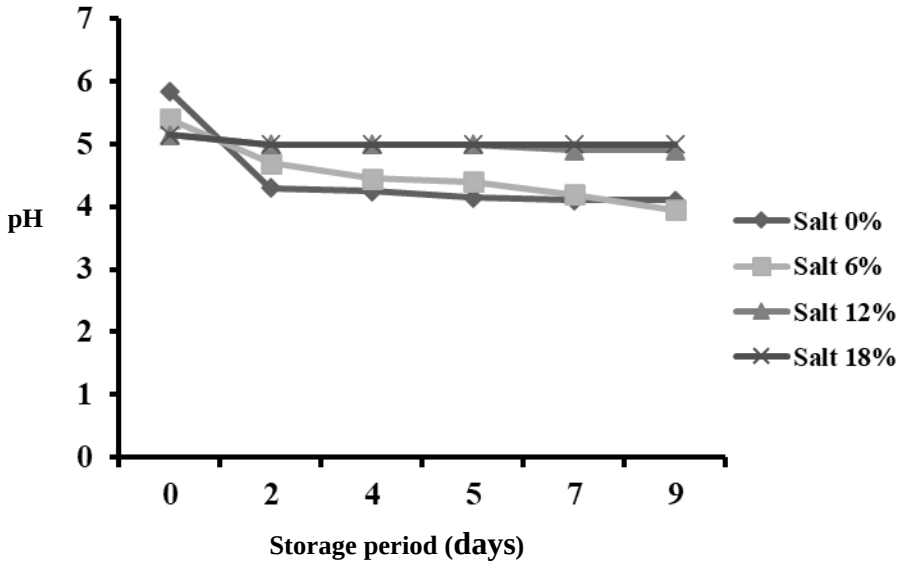

Fig 1. The changes of pH of stored ground chili

The water content of ground chili increased during storage. The most significant increase was ground chili without salt (0%) and the least experienced increase in water content was ground chili with 18% salt concentration. Changes in the water content of ground chilies with the addition of salt can be seen in **Fig 2**. At the time of giving salt, ground chilies will undergo an osmosis process where water will be absorbed from the material and the body of decaying microorganisms so that their metabolism is disturbed and eventually die. This is what causes the shelf life of food to be longer (Andre Silva Vidal et al., 2019). Due to the fact that salt lowers the

water content of ground chili it is useful as a preservative. The capacity of sodium and chloride ions to bind with water molecules is thought to be the reason salt can reduce water content.

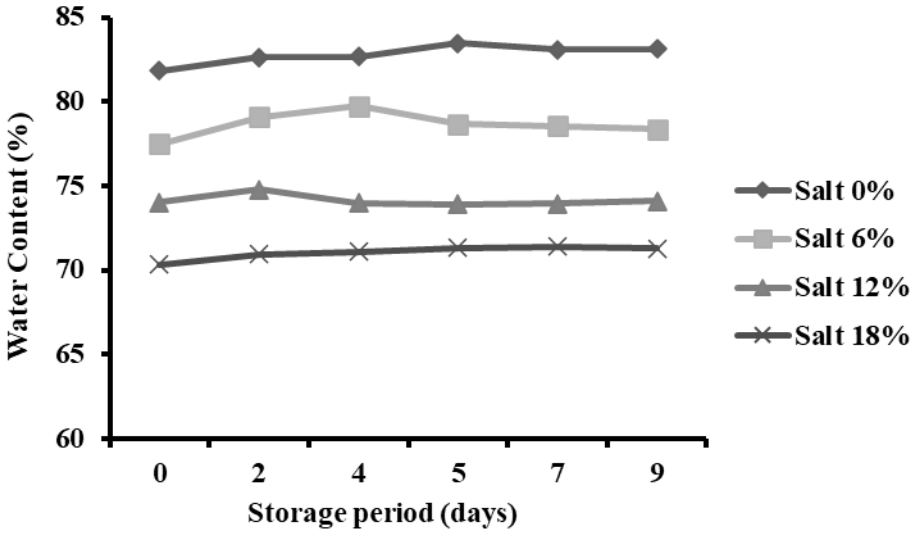

Fig 2. The changes of water content of stored ground chili

The total titrated acid of ground chili during storage also increased. A significant increase occurred in ground chili with 0% treatment. The increase in total titrated acid was due to the fermentation process caused by lactic acid bacteria. It is this lactic acid bacteria that can break down sugar into organic acids, causing total acid to increase (Anggraeni et al., 2021). The change in total titrated acid can be seen in **Fig 3**. In most cases, salt is essential for food fermentation. A typical method of food preservation is fermentation, in which specific types of bacteria turn fresh foods into acceptable foods that may be maintained for longer periods of time than their fresh counterparts. Many of the qualities of foods like pickles, sauerkraut, cheeses, and fermented sausages can be attributed to the action of lactic acid bacteria. While preventing the growth of harmful spoilage bacteria and fungi that are already present in these foods naturally, salt encourages the growth of these more salt-tolerant, helpful species.

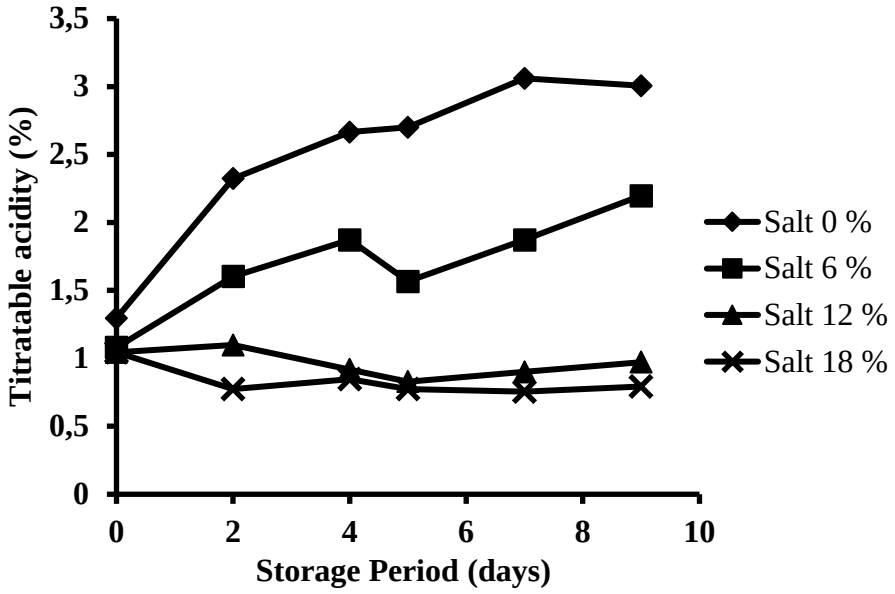

Fig 3. The changes of Total Acid Titrated of stored ground chili

Furthermore, salt can aid to improve flavor and color. Through the regulation of the biochemical and enzymatic events, it can influence the flavor and color of treated products (Çarkcioğlu et al., 2016; Flores et al., 2015). Adding salt causes the ^{o}Hue of chili gliding to increase during storage. This indicates that the more salt added to the ground chili, the higher the ^{o}Hue during the shelf life, which means that the red color is slightly reduced. This indicates a reduced content of β-carotene in ground chili[6]. The changes of ^{o}Hue of ground chili can be seen in **Fig 4**. Carotenoids will undergo changes during storage caused by isomeration and enzymatic and non-enzymatic oxidation. The color change during storage was caused by the activity of microorganisms which caused damage to the red pigment as a result of cutting the pigment structure into other simpler components so that the color changed to dark.

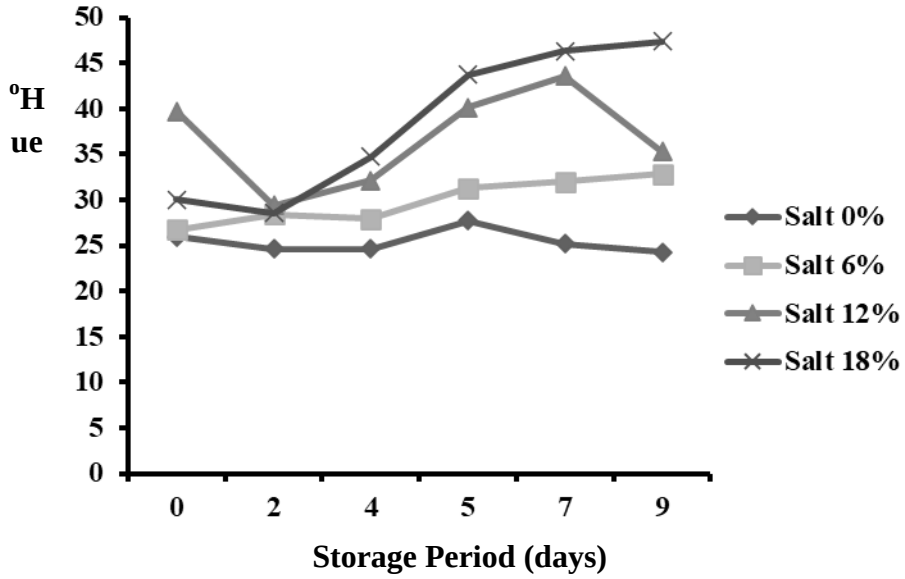

Fig 4. The changes of ^{o}Hue of stored ground chili

Table 1 indicates the total plate count number of microbes in ground chilies. Salt treatment can greatly inhibit microbial growth in ground chilies that have been stored. These results indicated that the more salt concentration added, the fewer the number of microbes that grow on the chili, and conversely the less salt added is the more microbes grow on the material. 12% and 18% treatment can significantly suppress microbial growth compared to 1% and 6% salt treatment. This shows that the 12% treatment was strong enough to restrain the growth rate of microbes. The salt solution has an osmotic pressure that causes microbial cells to lyse that causes their growth can be inhibited. The number of microbes in ground chili is still high because ground chili has not gone through the processing process (Ratnasari et al., 2014; Michelakou et al., 2021; Inguglia et al., 2017). So far, there is no standard regarding the maximum limit of total microbial content in ground chilies and when compared with the quality requirements of chili sauce which does not exceed 1.0 x 10^4 colonies/g. The high total microbial content in ground chili compared to standard chili sauce is due to the processing of ground chili which does not use a heat process which can reduce the initial microbial count.

Table 1. The total microbes growth during storage of ground chilies

Storage periods	The total plate count number (colonies/g)			
	0 %	6 %	12 %	18 %
0	$5,8x10^3 \pm 0,15$	$5,8x10^3 \pm 0,15$	$5,8x10^3 \pm 0,15$	$5,8x10^3 \pm 0,15$
2	$9,1x10^4 \pm 0,9$	$9,8\ x10^4 \pm 0,30$	$6,8\ x10^4 \pm 0,30$	$6,1\ x10^4 \pm 0,30$
4	$2,3x10^5 \pm 0,05$	$1,6\ x10^5 \pm 0,05$	$9,6\ x10^4 \pm 0,05$	$8,6\ x10^4 \pm 0,05$
5	$8,1\ x10^5 \pm 0,1$	$3,9\ x10^5 \pm 0,20$	$1,0\ x10^5 \pm 0,20$	$9,7\ x10^4 \pm 0,20$
7	$2,5\ x10^6 \pm 0,1$	$2,3\ x\ 10^6 \pm 0,05$	$8,8\ x\ 10^5 \pm 0,05$	$5,0\ x\ 10^5 \pm 0,05$
9	$3,6\ x10^6 \pm 0,1$	$2,8\ x10^6 \pm 0,1$	$1,4\ x10^6 \pm 0,1$	$1.0\ x10^6 \pm 0,1$

Conclusion

The addition of salt to ground chilies can extend the shelf life of chilies. This study determined that the optimal salt content for preserving the quality of fresh ground chili stored under ambient circumstances was 18% salt. Maintaining the quality of ground chili is also fairly well-able with treatment at 12% concentration. The percentage of salt that can be processed, at the very least, was 12%, and the ideal concentration was 18%.

Acknowledgments

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Conflict of Interest

Authors declare that they have no conflicts of interest.

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