Application of Liquid Smoke and Chitosan as Natural Preservatives for Tofu and Meatballs

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Abstract

Food can be occur physical and chemical changes mainly spoilage. To avoid this, the food is often added preservatives. Food preservatives currently very concerned about his safety, especially formaldehyde is often used when very dangerous to health. Therefore, it is necessary to study a natural preservative to replace harmful chemical preservatives including liquid smoke and chitosan. This study aims to determine the shelf life of tofu and meatballs after addition of liquid smoke and chitosan. Giving liquid smoke and chitosan on tofu is done by immersion, while the meatballs made by mixing liquid smoke and chitosan into the boiling water of meatballs. Then samples tofu and meatballs were analyzed TPC and organoleptic tests. Results showed addition of liquid smoke with a concentration of 1.5% and chitosan 2.5% is able to extend the life of tofu and meatballs for three days.

Keywords : chitosan, liquid smoke, meatballs, natural preservative, tofu

1. Introduction

Food is a basic need for humans. The food needs will continue to increase in line with population growth. Food will undergo changes among other undesirable spoilage and rancidity. The process of decay and rancidity is caused by the chemical reaction that comes from within and from outside of the food.

Food preservatives included in the group of food additives that are pharmacologically inert (effective in small quantities and not toxic). The use of preservatives is very wide, almost the entire industry to use it, including the pharmaceutical, cosmetic, and food. However, the use of preservatives on the market there are still many materials that are prohibited by BPOM (Agency for Food and Drugs supervisor), such as formaldehyde, which is commonly used for meatballs and tofu, with low cost reasons and the products look better and last longer.

The use of synthetic chemicals as preservatives in food is very worrying, because it causes many the health and environment problems. At this time there are still many the use of prohibited preservatives such as formaldehyde and borax.

More than 700 types of food in traditional and modern markets in seven cities proved using formalin (BPOM 2006). Formalin is a chemical compound formaldehyde-based are commonly used for the bodies preservatives. Formalin is suspected to cause cancer (carcinogens agent) (Dewanti 2006). For that, we need a natural preservative as an alternative to substitute synthetic preservatives. One of natural preservative is liquid smoke and chitosan.

2. Materials and Methods

Natural preservative that is used was liquid smoke and chitosan. Liquid smoke is used for the study was obtained from the market under the brand *Diogreen*. Chitosan is used is in the form of powder obtained from the market. Research the use of liquid smoke and chitosan done to extend the shelf life of the product tofu and meatballs.

Research on the use of liquid smoke in tofu, using liquid smoke concentration among other things : AT1 (0.5 %), AT2 (1.0 %), AT3 (1.5 %), AT4 (2.0 %) and controls (AT0). Giving liquid smoke made by mixing it into tofu soaking water for 1-3 days. Research on the use of liquid smoke in meatballs, using different concentrations ie AB1 (0.5 %), AB2 (1.0 %), AB3 (1.5 %), AB4 (2.0 %), and AB0 (control). Giving liquid smoke made by mixing it into meatballs boiling water, after the dough is molded, meatballs boiled until cooked which are marked meatballs on the surface.

Using chitosan on tofu at different concentrations ie KT1 (1.0 %), KT2 (1.5 %), KT3 (2.0 %), KT4 (2.5 %) and KT0 (without chitosan). Giving chitosan made by mixing it into tofu soaking water for 1-3 days. For other research used chitosan on meatballs at different concentrations namely : KB1 (1.0 %), KB2 (1.5 %), KB3 (2.0 %), KB4 (2.5 %) and KB0 (control). Giving chitosan made by mixing it into meatballs boiling water, after the dough is molded, meatballs boiled until cooked which are marked meatballs on the surface.

After the addition of liquid smoke and chitosan, then be analyzed Total Plate Count (Fardiaz 1987) and organoleptic testing (Soekarto 1985) on product samples of tofu and meatballs. Each treatment is done with three replications.

3. Results and Discussion

3.1 Analysis Total Plate Count on Tofu and Meatballs Applications of Liquid Smoke and Chitosan

The content of bacteria in a product is one microbiology parameter in determining the appropriateness of the product consumed (Kristinsson et al. 2007). It is necessary for the analysis of a product and determine microbial growth (indicator can be either Total Plate Count) in the product during storage. The results of the analysis of total plate count in the sample of tofu application of liquid smoke and chitosan on the observation day 1 to day 3 are presented in Table 1 below.

Table 1: Results of the analysis of TPC in tofu application of liquid smoke and chitosan on Day 1, 2, 3

Samples	Total Plate Count (colony/g)		
	Day 1	Day 2	Day 3
AT1	1.2×10^{5}	1.43×10^{7}	1.43×10^{8c}
AT2	1.07×10^{5}	1.43×10^{6}	1.43×10^{7b}
AT3	1.03×10^{5}	1.57×10^{6}	1.57×10^{5a}
AT4	1.27×10^{2}	1.17×10^{4}	1.17×10^{7b}
KT1	1.7×10^{4}	1.73×10^{5}	1.3×10^{8c}
KT2	1.87×10^{4}	1.4×10^{5}	1.47×10^{7b}
KT3	1.6×10^{4}	1.6×10^{5}	1.57×10^{7b}
KT4	1.6×10^{2}	1.43×10^{3}	1.56×10^{5a}

Note : AT1 (liquid smoke 0.5%,), AT2 (liquid smoke 1.0%), AT3 (liquid smoke 1.5%), AT4 (liquid smoke 2.0%) KT1 (chitosan 1.0%,), KT2 (chitosan 1.5%), KT3 (chitosan 2.0%), KT4 (chitosan 2.5%)

Total Plate Count values based on tofu after application of liquid smoke and chitosan, it can be said that the number of microorganisms on the product know tends to increase with the length of storage in liquid smoke addition of 0.5%, 1.0% and 2.0% as well as on the use of chitosan at a concentration of 1.0%, 1.5%, 2.0% and 2.5%. Results of laboratory tests on the value of TPC on tofu application of liquid smoke and chitosan on the 1st day averaging around 10^{3} colonies for all concentrations. On day 3, the lowest value of TPC of tofu was 10^{5} found in 2.5% chitosan concentration and liquid smoke concentration of 1.5%. While tofu using chitosan and liquid smoke other concentration has reached the TPC 10^{7} where the sum of TPC is already past the TPC value is allowed to SNI 01-3142-1998 tofu of 10^{5}.

This condition showed that the use of chitosan at 2.5% and 1.5% liquid smoke to maintain the quality of tofu until 3rd day and still suitable for consumption. While the use of other concentrations, it is not feasible to condition of tofu consumed because it has suffered a setback as a result of bacterial quality. Visually, signs that can be used to determine the occurrence of the damage out among others is out slimy surface, texture is soft, reduced compactness, color and appearance are not bright and sometimes moldy on the surface as well as the damage is characterized by a sour taste and bacterial growth.

Furthermore, the results of the analysis of total plate count in the sample meatballs application of liquid smoke and chitosan on the observation day 1 to day 3 are presented in Table 2 below.

Table 2: Results of analysis of TPC in meatballs application of liquid smoke and chitosan on Day-0, 3

	Total Plate Count (colony /g)	
Samples	Day-0	Day-3
B0 (control)	2.6×10^{4}	5×10^{7d}
AB1	5×10^{1}	1.5×10^{7d}
AB2	3.5×10^{2}	2.6×10^{7c}
AB3	7.1×10^{3}	1.4×10^{5a}
AB4	1.0×10^{2}	2.6×10^{6b}
KB1	2.1×10^{2}	2.4×10^{8d}
KB2	5.5×10^{1}	2.8×10^{7c}
KB3	4.0×10^{1}	2.9×10^{6b}
KB4	4.0×10^{1}	2.2×10^{5a}

Note : AB1 (liquid smoke 0.5%), AB2 (liquid smoke 1.0%), AB3 (liquid smoke 1.5%), AB4 (liquid smoke 2.0%), KB1 (chitosan 1.0%), KB2 (chitosan 1.5%), KB3 (chitosan 2.0%), KB4 (chitosan 2.5%)

The result showed the value of TPC on meatballs during storage that is allowed to be consumed was meatballs with applied chitosan at 2.5% and liquid smoke concentration of 1.5%. Thus a dose of liquid smoke 1.5% and 2.5% chitosan is able to extend the life of meatballs than other concentration of liquid smoke and chitosan or with no natural preservatives (control). The number of bacteria in the meatballs with chitosan concentration of 2.5% and liquid smoke 1.5% on day 3 was 10^5 while the other concentration of liquid smoke and chitosan amount exceeds the value of TPC are allowed on meatball products is between 10^6-10^8. TPC values are allowed in accordance with SNI 01-3819-1995 meatball that is equal to 10^5.

Thus the liquid smoke with a concentration of 1.5% and 2.5% chitosan was able to extend the life of the control meatballs until 3rd day, and meatballs can be consumed. Mixing liquid smoke and chitosan in boiling water is more effective to improve the lasting power meatballs with observed that the onset of physical changes in the mucus meatballs. The results of the study Zuraida (2008) mixing liquid smoke in boiling water meatballs began to look slime at 24 hours for the concentration of liquid smoke 1.0% to 2.5% and without the addition of liquid smoke has formed slime on the 16th hour. Siskos et al. (2007) stated that the mixing of liquid smoke in the boiling water will coat the outside of the meatballs and seep into the meatballs.

Liquid smoke is a result of condensation of steam distillation or the results of indirect and direct combustion of carbon-containing materials, and many other compounds. The role of liquid smoke in the preservation of food is influenced by the content of phenolic compounds that function as antioxidants and bateriostatic, as well as the components that affect the pH and acid taste (Widyastuti et al. 2012). Liquid smoke have the matter content of 4.13% phenol, carbonyl 11.3% and 10.2% acid that functions as a barrier to the development of bacteria and is able to preserve food and quite safe as a natural preservative. Liquid smoke contains several antimicrobial agents, among others, is an acid and its derivatives (formate, acetate, butyrate, propionate and metal ester), alcohol (metal, ethyl, propel, alkyl and isobutyl alcohol), aldehyde, ketone, phenol, pyridine and pyridine metal (Siskos et al. 2007). Results of research into the use of liquid smoke that has been carried out, among others, are the skipjack fish marinated in liquid smoke 2% for 15 minutes (Haras 2004); eel fish marinated coconut shell liquid smoke concentration of 30% for 15 minutes (Febriani 2006); manufacture of smoked milkfish in Sidoarjo (Hadiwiyoto et al. 2000).

Chitosan is a waste or by-products from shrimp and crab processing. Chitosan contains polication so as to inhibit the growth of bacteria and fungi. Mechanisms antimicrobial suspected occurring binding cationic ion presence of chitosan with sialic acids in the phospholipids that resist the movement of microbes.

In addition, penetration of chitosan oligomers into the cell of microorganisms thus preventing cell growth by preventing the transformation of DNA into RNA (Hafdani and Sadeghinia 2011). Chitosan is used as an edible coating on perishable food such as fresh fruit, bread, meat, eggs, tofu, fish, milk and others so as to reduce decay (Vargas et al.2006, No et al. 2007). Chitosan as a coating can improve the shelf life and quality of bread by inhibiting microbial growth and slow down oxidation. The bread is coated chitosan 1% and 2% were dissolved 0.3% lactic acid can retain for 8 days (Ahn et al. 2003). The effectiveness of the addition of chitosan in maintaining storage stability has been reported by Darmadji and Izumimoto (1994) that the addition of 1% chitosan on beef can lower TBA value by 70% for 3 days of storage at 4 °C, even after 10 days of storage TBA value is almost the same at day 0 storage. The use of 0.5% water-soluble chitosan on immersion tofu can extend the shelf life of tofu for 7 days at 4 °C (Chun et al. 1997).

3.2 Organoleptic Analysis Tofu and Meatballs Sample Application of Liquid Smoke and Chitosan

Organoleptic test is a way of assessing the quality of a product by using the sensitivity of the human senses, namely sight with eyes, smell with nose, taste with the oral cavity, and grope with fingertips. A level is referred to as the hedonic scale really like, like, regular, not like, really do not like.

Response panelists for color, aroma, texture tofu with application of liquid smoke and chitosan can be seen in Table 3 below.

Table 3: Analysis of color, aroma and texture in tofu application of liquid smoke and chitosan

Concentration of Liquid Smoke	**Response of Tofu Quality**		
	Color	Aroma	Texture
Control	2.70d	2.50d	3.00c
0.5%	2.90c	2.78cd	3.56b
1.0%	2.96c	3.48c	3.89b
1.5%	5.80a	4.08a	4.04a
2.0%	4.00b	3.40b	3.36b
Concentration of Chitosan	**Response of Tofu Quality**		
	Color	Aroma	Texture
Control	2.70d	2.50d	3.00c
1.0%	2.90c	2.78cd	3.56c
1.5%	2.96c	3.48c	4.48b
2.0%	3.76b	4.08b	5.04a
2.5%	5.24a	5.40a	5.36a

Based on Table 3, it is seen that the panelists preferred the color, aroma and texture tofu that is applied chitosan at a concentration of 2.5 % than with other concentration and control. Based on the analysis of variance for the parameters of color, aroma and texture tofu at 5% confidence level is known that the concentration of chitosan in immersion tofu significantly different. Duncans further test each sample tofu with 5 different concentrations between samples tofu applied chitosan concentration of 2.5 % compared with the sample tofu applied chitosan with a concentration of 1.0% , 1.5 % , 2.0 % and 0 % (control) significantly different that can be said that the chitosan concentration of 2.5 % resulted in color, texture and aroma are preferred because not to change the color, texture and aroma during storage period.

Response of panelist on the color , aroma and texture meatballs with application liquid smoke and chitosan can be seen in Table 4

Table 4: Analysis of color, aroma and texture in meatballs application of liquid smoke and chitosan

Concentration of Chitosan	**Response of Meatballs Quality**		
	Color	Aroma	Texture
Control	2.70d	2.50d	3.00c
1.0%	2.90c	2.78cd	3.56c
1.5%	2.96c	3.48c	4.48b
2.0%	3.76b	4.08b	5.04a
2.5%	5.24a	5.40a	5.36a
Concentration of Liquid Smoke	**Response of Meatballs Quality**		
	Color	Aroma	Texture
Control	2.70d	2.50d	3.00c
0.5%	2.97c	2.84c	2.56c
1.0%	2.90c	2.78c	3.56c
1.5%	4.96a	4.48a	4.48a
2.0%	3.76b	3.08b	3.04b

Table 4 showed that the panelists preferred the color, aroma and texture of the meatballs were applied liquid smoke with a concentration of 1.5 % than with other concentration and control. Based on the analysis of variance for the parameters of color, aroma and texture meatballs at 5% confidence level is known that the concentration of the immersion of liquid smoke on meatballs significantly different. Duncans further test each sample meatballs with 5 different concentrations between samples meatballs liquid smoke concentration of 1.5 % compared to samples of meatballs with a concentration of 0.5 %, 1.0 %, 2.0 % and 0 % (control). Further panelists preferred the meatballs with chitosan concentration of 2.5% compared to the concentration of the other treatments. Therefore, it can be said that liquid smoke concentration of 1.5 % and 2.5 % of chitosan concentration were added to the boiling water meatballs, produce colors, textures and aromas that are preferred because of not change the color, aroma and texture during storage period.

A quality assessment of products for color, aroma and texture intended that the product is acceptable for consumption. It happens in tofu and meatballs were preserved with liquid smoke and chitosan. As for tofu and meatballs in the control (without using liquid smoke and chitosan) on day 2 had lapsed. One sign of damage tofu and meatballs is the formation of mucus which indicates the growth of bacteria. Mixing liquid smoke and water boiled meatballs chitosan is more effective to improve the storability of meatballs. Siskos et al. (2007) states that the mixing of liquid smoke or chitosan in boiling water will coat the outside of the food products and penetrate the inner product so that liquid smoke and chitosan can act as an antibacterial and antimicrobial in the shelf life of food so that food will last longer and suitable for consumption.

4. Conclusions

Liquid smoke and chitosan can be used as a natural preservative in tofu and meatballs replace synthetic preservatives. Giving liquid smoke with a concentration of 1.5% and 2.5% of chitosan is able to extend the life of tofu and meatballs for three days. Based on the results of organoleptic test, panelists preferred the color, aroma and texture tofu that is applied chitosan at a concentration of 2.5%. While the meatball samples, panelists preferred the color, aroma and texture of the meatballs are applied liquid smoke with a concentration of 1.5%.

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