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Egg Chip Quality with Different Types and Levels of Fillers

Kartina Kartina[1], Nahariah Nahariah[2],Fatma Maruddin[2] and Hikmah M. Ali[2]

[1]Graduate of Animal Science, Hasanuddin University, Jalan Perintis Kemerdekaan Km.10, Makassar 90245, Indonesia
[2]Lecturer in Department Animal Product Technology, Faculty of Animal Science, Hasanuddin University, Jalan Perintis Kemerdekaan Km.10, Makassar 90245, Indonesia

*Corresponding author:E-mail: kartinaunhas@gmail.com

Abstract

Infertile egg, generally, is only as an industrial waste hatching although it could be prepared as a valuable product. Therefore, it is needed some efforts to improve is quality. One of the attempts applied is by processing techniques to produce egg chips. This product resembles a thin plat, small, and solid. The study aimed to determine the physicochemical quality of egg chips. The study employed a completely randomized design with factorial 3 x 3. Factor A was the type of filler including soy powder, tapioca powder, and a combination of both. Factor B was filler level (%) 0, 3, and 6. The variables observed were hardness, friability, solubility, and moisture content of chips. The results showed that the types of fillers had a highly significant effect ($P<0.01$) on dissolution time. The addition of filler level significantly affected ($P<0.05$) on hardness, friability, and solubility. There was an interaction between types and levels of filler material against hardness and solubility. The addition of tapioca powder at the level of 3% in making egg chips could increase hardness, not fragile, the fast solubility time. However, the egg chip did not undergo changes in water content.

Keywords: Infertile eggs, hatching, fillers,eggs chip

INTRODUCTION

Egg is one of the foods containing high nutrition, but it relatively has a short shelf life (Miranda *et al.*, 2015). The quality of egg will decrease during storage (Vickova *et al*., 2019). However, the egg quality can be extended by storing in powder form. Further, the egg powder can be processed into egg chips to prevent damage and increase the added value of eggs.

In general, eggs circulating in the community are infertile eggs. Infertile eggs are eggs that are not fertilized by males. This kind of eggs can be found in the market at low prices. By candling, there are no embryos found in the eggs so must be rejected from the hatchery industry.

The infertility of eggs can be caused by various possibilities such as the ratio between males and broodstock which is less balanced, malnutrition of males and broodstock, age of males or broodstocks that are too old (Nuryati *et al*. 2002). The infertile eggs originating from the hatchery industry have low physical quality. These infertile eggs have fused egg whites and yolk,. but they are still eligible for consumption purposes (Brandelli *et al*., 2015) In addition, the quality of infertile egg is lower than consumption eggs.Therefore, efforts are needed to improve the quality of infertile eggs so that they can be used as raw materials for making products. Further processing products are such as egg chips. Egg chips are food products in the form of thin, small and solid plates. The manufacture of egg white chips had been investigated by the addition of sago 10% and produced good quality egg chips. However, research on egg chips made from infertile eggs had never been carried out.

Infertile eggs generally only become industrial waste, so efforts are needed to improve their quality by processing them into food products in the form of thin, small, and solid chips (chips). Infertile eggs have a low quality so using a freeze dryer. Freeze dryer can maintain the quality of the results of drying, avoid changes in aroma, color and other organoleptic elements, and maintain the stability of the structure of the material. Making infertile egg chips requires good fillers to produce good quality egg chips. The intended fillers are tapioca powder, soy powder and a combination of both. Tapioca powder contains high carbohydrate and soy powder contains high protein which is expected to improved the physicochemical quality of the infertile egg chip leftover from the hatching industry and improve the nutritional value and extend its shelf life. The addition of fillers, the product will have quality advantages, both from the physicochemical (hardness, fragility, soluble time and water content), taste and color.

The purpose of this study was to determine the physicochemical quality including hardness, fragility, soluble time and water content of chips from infertile eggs left over from hatching industry based on the types of filler material (soy powder, tapioca powder and combination of both) with different levels.

MATERIALS AND METHODS

Research Procedure

The equipments used in this study were cups, plastic containers, mixers, scales, freeze dryers, petri dishes, blenders, plastic clips, filter paper press, incubators and chip molds. The material used was tapioca powder, soy powder, glucose, alcohol and chlorine solution. Eggs were obtained from the hatchery in Maros, South Sulawesi, Indonesia.

Sample Preparation

The dried eggs were cruched until smooth. Furthermore, making egg chips by adding of fillers : soy powder, tapioca powder and combination of both (tapioca powder: soy powder = 1: 1). The levels employed were 0%, 3%, 6%, respectively. The manufacturing egg chips used a paper filter pressed by a pressure 60 N for 1 minute. The pressed chips were using aluminum foil and then dried in an incubator at 70^0C for 5 minutes. The variables measured were hardness, fragility, dissolution time and water content.

RESULTS AND DISCUSSION

Hardness

The result of the study indicated that the hardness of the eggs chips were not different among types of filler as presented in table (P>0.05). However, It was markedly different among levels of filler employed (P<0.05) (Table 1). There were a very significant interaction between types and level of filler employed (P<0.01).

Table 1.Hardness (kg/cm^3) of infertile egg chips from the hatching industry results in different types and levels of filler

Type of Filler Material	Hardness: Level of The Filler (%) 0	3	6	Average
Soy Powder	15.51±1.15	15.81±1.20	15.81±1.14	15.71±1.02
Tapioca Powder	13.07±1.69	14.83±1.07	18.75±1.68	15.55±2.84
Combination Powder	13.90±1.40	14.55±1.71	14.84±0.90	14.43±1.27
Average	14.16±1.64^a	15.06±1.31^a	16.47±2.08^b	15.23±1.90

Description: Different superscripts in the same column or row show significant differences (P <0.05)

The hardness of the infertile egg chips from the hatching industry by addition of filler level between 0% to 3% was not significantly different. However, the addition 6% filler level will increase the hardness of the infertile egg chips of the hatching industry to ± 16.47 kg / cm^3. It indicated that the addition of fillers up to 6% could increased the hardness of the infertile egg chips from the hatchery industry. The increasing concentration of material used can increase the value of hardness. This had due to differences in the concentration of ingredients used for each tablet / chip. Fillers that contain cellulose could increase the tablet's compactibility very high compared to other fillers (Krok *et al*. 2017).

Data shown in Table 1 indicates that the hardness value of the eggs chips reached higher hardness than others study results. But this is due to differences in the concentration of the material used. Parrot (1970) stated that a good quality of chips must have a hardness 4 kg/cm^3. Hardness of egg chips less than 4 kg/cm3 is still acceptable as long as the fragility does not exceed the specified limit. Chips/tablets that are not hard will experience fragility during packaging and transportation. However, further (Rhoihana, 2008) stated that the hardness of the chip/tablet which was more than 10 kg/cm3 is still acceptable, as long as it still met the required disintegration time requirements. Nnamani *et al*.(2017) stated that chips that had a good hardness are around 9-10 kg/cm^3 and low fragility.

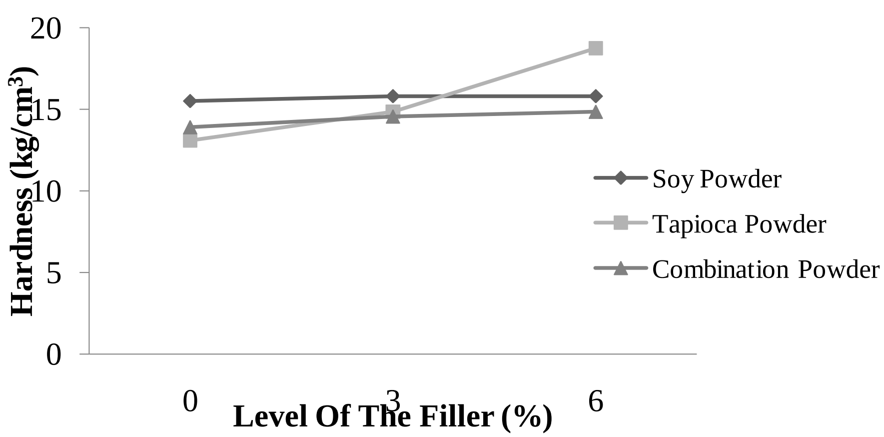


Figure 1.Interaction of Types and Levels of Fill Material to the Hardness of Infertile Egg Chips, which results from hatching industry

Based on the analysis of variance, there were significant interactions ($P<0.05$) between the type and level of filler material on the hardness of the infertile egg chip from the hatching industry. In the interaction, there was an increase in hardness of the infertile egg chip, the rest of the hatchery industry results at the level of 6%, both the addition of tapioca powder or combination powder. Addition of soy powder decreased at the level of 6%. The addition of tapioca powder at the 6% level results in a higher value of infertile egg chip hardness remaining from the hatchery industry. This showed that the maximum level of addition of tapioca powder and combination powder to increase the hardness of the infertile egg chip from the hatching industry results is at the level of 6%, and the level of soybean powder used to increase the hardness is at the level of 3%. This is due to tapioca powder having good heat conductivity so that it can accelerate cooking and drying as well as good adhesion (Dwicahyo, 2008). The stickiness of tapioca powder can make a solid infertile egg chip, so that the egg chip has a high hardness.

Fragility

The fragility of the infertile egg chips remaining from the hatchery industry by the addition of different types and levels of fillers is presented in Table 2.

Table 2.Fragilityof infertile egg chips from the hatching industry results in different types and levels of filler

Type of Filler Material	Fragility			
	Level of The Filler (%)			Average
	0	3	6	
Soy Powder	3.46±0.10	3.14±0.10	3.12±0.08	3.24±0.18
Tapioca Powder	3.35±0.15	3.15±0.16	3.11±0.45	3.20±0.28
Combination Powder	3.18±0.17	2.81±0.28	3.26±0.10	3.08±0.27
Average	3.33±0.18^{b}	3.03±0.24^{a}	3.16±0.25^{ab}	3.17±0.25

Description:Different superscripts following the mean value on the same line show significant differences ($P<0.05$). 1 = highly fragile, 2 = very fragile, 3 = fragile, 4 = slightly fragile, 5 = not fragile

The results of the analysis of variance (Table 2) showed that the increase in the level of filler had a significant effect ($P<0.05$) on the fragility of the infertile egg chip remaining from the hatchery industry. The types of filler material as well as the interaction between the types and levels of filler material did not significantly affect the fragility value of infertile egg chips from the hatchery industry. These results indicated that the types of filler material did not contribute to the fragility of the infertile egg chip from the hatchery industry. The remaining infertile egg chips from hatchery industry results was better by adding 0% level which is 3.33 indicating fragility than adding 3% filler level and 6% showing very fragile.

Based on Table 2, it can be seen that the analysis of variance shows that there is a significant difference ($P<0.05$) among the level of filler material to the fragility of the remaining infertile egg chip from the hatchery industry. The addition of 0% powder could significantly affect the addition of fillers with levels 3% and 6% while the addition of level 3% to level 6% had no significant effect.This result indicated that the level of filler influenced on the fragility of the eggs chips. The higher the level of filler added, the egg chips was more fragile. Type of filler material containing acetylated starch exhibited low values of friability compared to the other of filler material, implying that acetylation produced tablets with fewer tendencies to abrasion. Conversely, pregelatinized starch containing formulations had higher friability values (Lawal *et al*. 2015). Good chips must have fragility not more than 1% (Parrott, 1971).

The average value of the infertile egg chip fragility remaining from the hatching industry has increased at the level of 0% by 3.327 which was a fragile egg chip and has decreased at the level of 3% and 6% by 3.033% and 3.161% which was a very fragile egg chip. The addition of fillers at the 0% level had a better fragility level compared to the addition of fillers at the 3% and 6% levels. Chips that are fragile and break easily in packaging and transportation will lose the heavy weight of the chip. Hasyim*et al*. (2012) stated that the fragility test is related to weight loss due to abrasion (erosion) that occurs on the surface of the egg chip. High fragility will affect the concentration/levels of active substances that are still present in the chip.

Solubility Time

The solubility time of the infertile egg chips remaining from the hatchery industry by the addition of different types and levels of fillers is presented in Table 3.

Table 3.Solubility time (minutes) of infertile egg chips from the hatching industry results in different types and levels of fillers

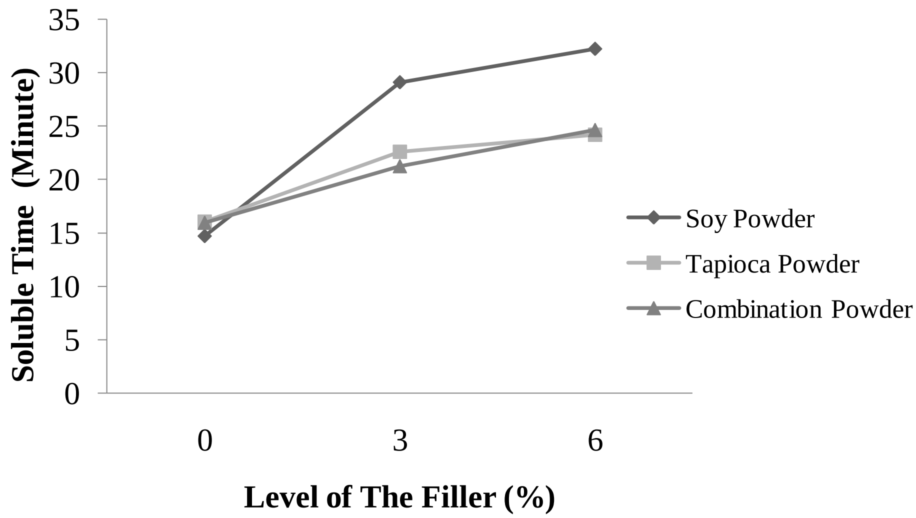
Soluble Time				
Type of Filler Material	**Level of The Filler (%)**			**Average**
	0	**3**	**6**	
Soy Powder	14.72±1.61	29.13±2.09	32.26±1.09	25.37±8.23^{b}
Tapioca Powder	16.09±0.45	22.61±0.65	24.23±3.30	20.98±4.09^{a}
Combination Powder	15.99±1.01	21.27±1.03	24.64±1.50	20.63±3.92^{a}
Average	15.60±1.18^{a}	24.34±3.84^{b}	27.04±4.35^{c}	22.33±5.96

Description: Different superscript in the same column or row show very significant differences (P <0.01)

The results of the analysis of variance, showed that the types and level of filler material had a very significant effect (P<0.01) on the solubility time of infertile egg chips from the hatchery industry. The interaction between the types of materials and the addition of levels had a very significant effect (P<0.01) on the solubility time in the infertile egg chips from the hatchery industry.

Further results of the filler level test showed that there was a very significant difference (P<0.01) between the level of filler and the soluble time of the infertile egg chips from the hatching industry. Based on the average soluble time of infertile egg chips, the types of filler experienced solubility in a longer time in soy powder and experienced solubility ina faster time in tapioca powder andpowder combination. The soluble time of the filler will affect the speed of dissolution of the infertile egg chip from the rest of the hacking industry. Fragile tablets / chips may dissolve easily, but these chips are not resistant to mechanical disturbances during distribution or storage (Hasyim *et al*. 2012).The long dissolved time is due to the filler having starch forming the hydrogel layer when interacting with a solvent or a liquid. This causes the length of time to disintegrate and slows down the time of the tablet/chips release (Larsson *et al*.2017). However, further (Caccavo *et al*. 2017) stated that fillers containing starch have a hydrogel layer which causes the difficulty of dissolution medium through the tablet so that it inhibits the dissolution process of the active ingredient.

Based on (Table 3) the average solubility time on infertile egg chips at low levels results in better solubility times compared to the addition of high levels. These results indicate that the lower the level, the faster the soluble time of infertile egg chips. A high average soluble time value in this study was obtained at the 6% level of 32.260.



Picture 2.Interaction of Types and Levels of Fill Material to the Soluble Time of Infertile Egg Chips, which results from hatching industry

Based on the analysis of variance, the interaction between type and level of addition of filler had a very significant effect ($P<0.01$) on the solubility time of infertile egg chips. Interaction shows that the increase in soluble time from level 0% to level 3%, both by giving soy powder, tapioca powder or combination powder. At the level of 6% dissolved time with the addition of soybean humps increased higher. Likewise with tapioca powder and combination powder are show a faster dissolving time.

Water Content

The water contentof the infertile egg chips remaining from the hatchery industry by the addition of different types and levels of fillers is presented in Table 4.

Table 4.Water content (%) of infertile egg chips from the hatching industry results in different types and levels of fillers

Water Content				
Type of Filler Material	**Level of The Filler (%)**			**Average**
	0	**3**	**6**	
Soy Powder	0.120±0.070	0.120±0.010	0.077±0.153	0.106±0.042
Tapioca Powder	0.123±0.066	0.090±0.036	0.083±0.025	0.099±0.044
Combination Powder	0.093±0.025	0.077±0.045	0.060±0.026	0.077±0.032
Average	0.112±0.052	0.096±0.035	0.073±0.022	0.094±0.040

Variance analysis (Table 4) shows that the types and levels of filler did not contribute to the water content ($P>0.05$) but, from the average value of the resulting moisture content decreased with increasing levels given, 0.112%, 0.096% and 0.073%. This shows that the water content in the filler used is low. Based on SNI 01-3451-1994 regarding the quality requirements of tapioca powder that is specified is a maximum of 15%.

Infertile egg powder which is made into chips is dried by the freeze dryer method so that the water content of the infertile egg chip from the hatchery industry results is low. According to Lestari (2012), drying using a freeze dryer is better than an oven because the water content is lower. According to SNI 01-4323-1996 states that the maximum moisture content of egg white powder is 8%. According to Poedjiadi (1994) the water contained in fresh egg whites reached 87%. The drying process can also reduce the amount of water contained in egg whites. The cause of high water content is due to the longer fermentation process due to changes in glucose into carbon dioxide and the higher the water. In the study of Nahariah *et al*. 2010, it was stated that the water content due to the addition of yeast and sucrose was related to the fermentation activity which could change glucose to produce volatile water during drying.

CONCLUSION

The results showed that addition of type and level of fillers material could improve the physicochemical quality of egg chips. The addition of tapioca powder at the level of 3% in making egg chips could increase hardness, not fragile, solubility time of fast. However the egg chip did not experience changes in water content.

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