J. Agric. Food. Tech., 1(8) 133-136, 2011

ISSN 2090 – 424X
Journal of Agriculture and Food Technology
www.textroad.com

PHYSICAL AND ORGANOLEPTIC QUALITY OF CHICKEN NUGGETS FRIED AT DIFFERENT TEMPERATURE AND TIME

Herly Evanuarini*, Hari Purnomo

Dept. of Animal Food Technology, Faculty of Animal Husbandry, University of Brawijaya, Malang, Indonesia

ABSTRACT

Physical and organoleptic quality of chicken nuggets prepared using different temperature and time were studied using Completely Randomized Design. Factors of this experiment were frying temperature of 160^o± 2^o C and 170^o± 2^{o}c, and the second factor was frying times namely, 1, 2 and 3 minutes. It was found that frying at 170^o C for 2 minutes gave the best nuggets with hardness value of 89.12N, cutting stress of 6.88N, elasticity of 0.273 min./g and the texture score was 6.84 whilst the taste score was 6.52 . Therefore, it can be concluded that for obtaining the best chicken nuggets from the physical and organoleptic quality point of view, frying temperature at 170^{o}C for 2 minutes is recommended.

Key words: chicken nuggets, frying temperature, frying time.

INTRODUCTION

Restructured meat is one of the meat processing technologies which utilize the relatively small size and irregular shape of meat to be processed into a wholesomeness meat product which could add of those small meat pieces. Some examples of this technology are corned beef, sausages and nuggets. Chicken nuggets which are most popular restructured meat prepared using chicken meat as raw material.

Spent hen which not producing eggs anymore or its egg production is very low (usually at the age of 24 months) have an unacceptable meat due to the tough texture or less tender compared to broiler meat. Therefore an effort should be considered to make use of this type of meat and its possibilities to added value by processing into product where those properties are not the prime consumers preference as it is already changed its form and hence more acceptable to the consumers. Incorporation of other ingredients might affect the quality of end products, although it is expected that some ingredients added should improve its quality.

Frying temperature and frying time could be influence the quality of product (Altunakar *et al*., 2004). Saguy and Pinthus (1995) reported that frying process could change the physical and chemical properties of the products include gelatinization and denaturation of protein as well as evaporation of its moisture. The frying process was transferring the product mass, indicated by transferring oil into the product and by migrating the water content of the product vapor to the frying oil.

Evanuarini (2002) stated that, egg white was used as the binding agent was aimed to obtain better nuggets quality. The best product was achieved by incorporating 10 % egg white as the binding agent. Based on this research, further research should be conducted to find out the effect of temperature and time of frying process to obtain a better quality of nuggets.

Mellema (2003) reported that the processing and cooking methods also affected the quality of end product. However there are very limited publication on the effect of frying temperature and time on physical and organoleptic quality of chicken nuggets. Therefore this study is aimed to find out the physical and organoleptic quality of chicken nuggets prepared using spent layer meat as raw material.

MATERIALS AND METHODS

Materials

Breast of spent hen meat of Hyline strain aged of 24 months were used as raw material for nuggets production, while the additional ingredients used were tapioca flour "Dua Naga" brand, bread crumbs, egg white, cooking oil, salt, garlic and white pepper were bought in local market.

Methods

Completely Randomized Design was used as its experimental design and the first factor in this experiment was the frying temperatures namely 160^o± 2^o C and 170^o± 2^{o}C, and the second factor was frying times: 1, 2 and 3 minutes respectively.

The parameters observed were hardness, cutting stress and elasticity according to the method by Carballo *et.al* (1996) and the organoleptic properties were measured

***Corresponding Author**: Herly Evanuarini, Dept. of Animal Food Technology, Faculty of Animal Husbandry, University of Brawijaya, Malang, Indonesia. E-mail: herly_evanuarini@yahoo.com

using the method describe by Lawless and Heyman (1998). The microstructure using Scanning Electron Microscope as mentioned by Montero *et.al.* (1997) .

Statistical analysis

The data obtained were analyzed using ANOVA and if there were significant differences the analysis was continued using Duncan Multiple Range Test. The microstructure micrograph were descriptively discussed.

RESULTS AND DISCUSSION

Physical properties of chicken nuggets

The statistical analysis showed that the interaction of treatments namely frying temperatures and times gave no significant effect (P>0.05) on the hardness of samples. The highest hardness value was found in sample fried at 170^{0}C for 3 minutes (101.37N), whilst the lowest one was found in sample fried at 160^{0}C for 1 minute (65,89N). Mean values of parameters observed were presented in Table 1.

Table 1 Means of hardness value, cutting stress and elasticity of chicken nuggets fried at different temperature and time.

Frying temperature ± (^{0}C)	Frying time (minute)	Hardness (N)	Cutting stress (N)	Elasticity (min./g)
160	1	65.89± 18.06	5.83 ±0,45	0.312 ±0.02
	2	78.60± 8.26	6.36 ±0.60	0.263 ±0.08
	3	97.60± 19.78	6.88 ±0.79	0.299 ±0.07
170	1	79.98± 12,43	5.57 ±0.23	0.355 ±0.08
	2	89.12± 11.62	6.88 ±0.39	0.273 ±0.01
	3	101.37±24.57	7.01 ±0.45	0.388 ±0.07

Means of these replication ± standard deviation

As the statistical analysis did not showed a significant difference, this means that those samples had a quite similar hardness values although there was an increase of hardness especially at the same frying temperature and different frying time.

Those differences are possibly due to the frying time as the longer time could affected the compactness of formed matrix, where interaction of protein from either egg white and chicken meat with starch.

Winarno (1997) reported that the denaturation might caused the opening of reactive groups of polypeptide chain due to expansion of disulfide cross-linking which contribute to harness of product. However, Singh *et.al.* (1995) also noted that frankfurter emulsion which was cooked at temperature from 550C to 900C showed an increase in hardness. It was found a linear correlation with cooking temperature from the cutting stress point of view.

However the higher frying temperature also increased the cutting stress value of the samples and this condition are related to the hardness value where the same phenomena were detected. The cutting stress average of fried nuggets with the effect of temperature and frying time was ranged from 5.57 N – 7.01 N.

The single factor namely frying time gave a significant effect(P<0.05) to the cutting stress of the samples, and this condition may be due to the longer the frying time the more crust were formed on the surface of the product. The formed crust made the texture harder and cutting stress became high. Saguy and Pinthus (1995) reported that a longer frying time will result a heat transfer from surface to the inner part of samples, hence the water in samples will then evaporate if the evaporation temperature had been reached. Budzaki and Seruga (2005) also reported a linear decrease in moisture content for french fries fried at 182^{0}C for 3 minutes. Albert *et al*(2009) note that crunchiness is a very important and a desirable texture of fried product. Cutting force may represent crust hardness.

These phenomena had been shown in this study by the highest values either the hardness as well as the cutting stress at frying time of 3 minutes for both frying temperatures .During frying, gelatinization and development of porous structure are related to the surface of chicken nuggets heated (Kassama and Ngadi, 2004).

In regards to the elasticity of the samples, the statistical analysis showed that the combination of frying temperature and time gave a significant effect (P<0.05). The elasticity average of fried nuggets with the effect of temperature and frying time is ranged from 0.263 minute/gram to 0.388 minutes/gram. However, frying temperature 160^{0}C was not statistically difference compare to the one at 170^{0}C, although the elasticity of samples slightly increased.

Food elasticity is usually synergic with its hardness, processing temperature, and the rate of protein denaturation. The frying of nuggets resulted in a crispy surface of the product as during frying there are water evaporation, whilst the starch granule were broken. This condition allow the oil to be absorbed into the product and during stander the nuggets after frying there will be oil dripping which leave some hollow matrix within the nuggets, and affected the elasticity of the end products. Heat is transferred from the frying oil to the surface of chicken nuggets.

Organoleptic properties of chicken nuggets

The frying temperature and time as well as their interaction gave a significant effect (P<0.01) on the texture and taste scores evaluated by the panelists. The means texture and taste scores of the samples were presented in Table 2.

Table 2 Means of texture and taste scores of chicken nuggets at different temperature and time

Frying temperature (^{0}C)	Frying time (minute)	Texture score	Taste score
160	1	6.41± 1.12^a	6.37± 1.25^p
	2	6.68± 1.05^b	6.67± 1.22^p
	3	6.49± 1.18^a	6.47± 1.14^p
170	1	6.56± 1.22^a	6.99± 1.13^q
	2	6.84± 1.25^b	6.52± 1.06^p
	3	6.61± 1.05^a	6.43± 1.09^p

Note: Means with same superscript at the same column were highly significant difference (P<0.05).

The texture scores of samples fried at either 160^{0}C or 170^{0}C for 2 minutes showed these samples were most preferred by the panelists and the possible reason was that by frying at this temperature for 2 minutes could produce nuggets with compact and solid texture as expected by the panelists. If the frying time extended up to 3 minutes the texture score was slightly decreasing, but the samples surface became more dried and tough and hence it was unacceptable to the panelists. So with 1 minute frying time it resulted with rubbery texture which also not preferred by the panelists. However a longer time of heating will also break the protein structure and denaturation of protein which resulted in a hard texture of the end product. Soeparno (1998) noted that the higher the cooking temperature and the longer cooking time, there will be a big lost of meat moisture until it reach a constant rate.

The taste accepted by the panelists was different, as this related to the acceptance of them as well as the nuggets texture resulted. It was found that nuggets which were fried at 170^{0}C for 2 minutes had the highest score. It seems that the frying temperature and time combination as mentioned above resulted the appropriate taste for the panelists and it is possibly due to the reaction of salt and glutamic acid(one of the meat amino acids) producing sodium glutamate compound which gave an umami taste. Winarno (1997) also stated that factors which affected the taste of a product were chemical compound, temperature, its concentration and interaction between other taste components.

Microstructure of chicken nuggets

The microstructure of samples was observed either at minced meat, chicken nuggets dough, steamed nuggets and fried nuggets at 170^{0}C for 2 minutes. The micrographs of these samples observed using Scanning Electron Microscope were presented in Figures 1– 4 as follow:

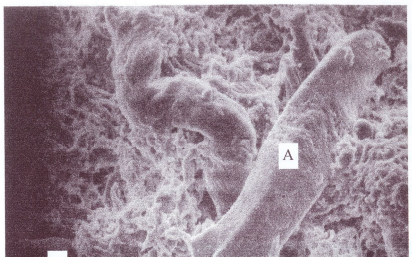

Figure 1. Microstructure minced meat (SEM, 500x, A= Muscle Tissue

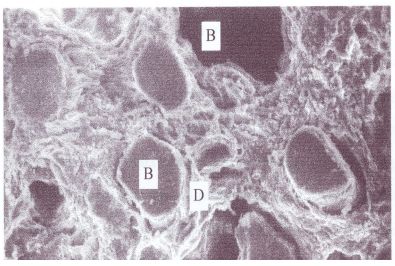

Figure 2. Microstructure nuggets dough (B=Cavity,C=Starch granule)

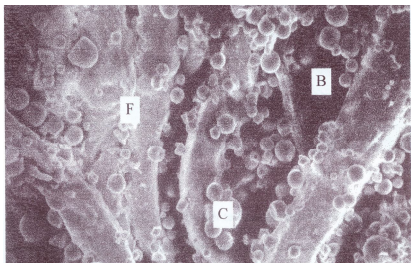

Figure 3. Microstructure of steamed nuggets(D=Gel of matrix)

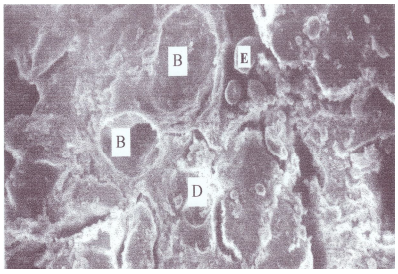

Figure 4. Microstructure of fried nuggets (B=cavity, D=Gel of matrix, E=Oil)

Figure 1 showed the microstructure of minced meat where some muscle although in broken form still observed (A) and this possible due to the not uniformly ground during the minced meat processing, hence it looked separated fiber and not compact with the other meat particles. While in Figure 2 the starch granules were distributed evenly at the meat surface (C) and still inact with varied size and form but relatively uniform in size as these granules were not yet intact as matrix as the dough was not yet heat treated. It is quite different at the Figure 3 where the matrix had been formed and therefore it was more compact with some cavity and it showed that the expansion of either starch granule and peptide chain occurred. The heat expansion of peptide chain can caused the opening of reactive site and resulting in rebinding at the same sites or the closely related such as the active site of amylase through hydrogen binding and a matrix was then formed. This strong binding matrix was formed due to the gelatisation process also occurred in the starches added.
The starch gelatisation will contribute to the strong binding within the matrix formed as this optimum expansion process also filled the cavity within the protein gel during heating process by cross linking and disulphide binding, thus a compact, solid and strong binding three dimensional protein-starch matrix were formed in the end products.
In Figure 4 there were more cavities observed in the micrographs and this possibly due to the evaporation of moisture during frying where the frying oil will then absorbed but during stranding the samples to cool it down there were oil drips and left the cavities opened as either moisture and oil which were trapped before was push out by heating and stranding the samples.

Conclusion

It can be concluded that spent hen meat can be used as raw material in the production of chicken nuggets by incorporating 10% egg white in combination with frying temperature of 170^0 C for 2 minutes this processing steps could gave the best end product with hardness value: 89.12N. Cutting stress: 6.88N, elasticity: 0.273 and the organoleptic properties score for texture: 6.84 and taste 6.52 . The microstructure observation of this product showed also changes of structure compared to the minced meat, nuggets dough, steamed and fried nuggets samples.

REFERENCES

Albert, A, Varela, P., Salvador, A. 2009. Improvement of crunchiness of battered fish nuggets. European Food Research and Technology 228, 923-930.

Altunakar, B., Sahin, S., Sumnu, G. 2004 Functionality of batters containing different starch types for deep-fat frying of chicken nuggets. European Food Research and Technology 218 (4): 318-322.

Budzaki, S., Seruga, B. 2005. Moisture loss and oil uptake during deep fat frying of " Krostula" dough. European Food Research and Technology. 220 (1): 90-95.

Carballo, J., Fernandes .,Baretto., Solas, M.T and Colmenero.1996. Morphology and texture of bologna sausages related to content of fat, starch, and egg white. Jurnal Food Science 61 (3) : 652-655.

Evanuarini, H.2002. Chicken nuggets quality affected by the egg white addition.Thesis. Animal Science. Postgraduate Brawijaya University. Malang Indonesia.

Kassama, L.S., Ngadi, M.O.2004. Pore development in chicken meat during deep-fat frying. Lebensmittel-Wissenschaft und Technologie, Food Science and Technology . 37(8): 841-847.

Mellema, M.2003. Mechanism and reduction of fat uptake in deep-fat fried food. Trends in Food Science and Technology 14 : 364-373.

Montero, P., Perez.,Mateos and T.I. Solas. 1997. Comparison of different gelation methods using washed sardine mince :Effects of temperature and pressure,J.Agric. Food Chem. 45 :4612-4618.

Saguy, I.S and E.F. Pinthus. 1995. Oil uptake during deep fat frying factors and mechanism. Food Technology 4:142-145.

Singh, R.P.1995. Heat and mass transfer in foods during deep-fat frying. Food Technology 4:134-137

Soeparno. 1998. Ilmu dan teknologi daging (Meat science science and technology) .Gadjahmada University and technology .Gadjahmada University Press.Yogyakarta.

Winarno, F.G.1997. Kimia pangan dan gizi (Food Chemistry and nutrition). PT. Gramedia. Jakarta.