Effect of Sodium Tripolyphosphate (STPP) to Physicochemical and Sensory Characteristics of Turkey Nuggets Derived from White and Dark Turkey Meats

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ABSTRACT

Turkey meat is a well-known foodstuff and source of protein in the United States, while in Indonesia turkey meat has not yet optimally processed as a foodstuff. The advantages of turkey meat are: has low calorie, high protein than other poultry meats, and good source of vitamin and mineral. Contrary to chicken meat, turkey meat has low fat content and high collagen, and therefore makes the meat very tough. This research was using two kinds of meat, the white meat (the breast) and the dark meat (the leg) for nuggets. These two parts have different characteristics, physically as well as chemically. This research was designed in a Nested Randomized Design where STPP were subjected to each part of turkey meat in four levels, 0.0, 0.2, 0.4 and 6.0%, respectively. The objective of this research was to find the most effectiveness of STPP and the most acceptable turkey nuggets. The results of this research were that STPP 0.6% was the best choice for white meat and STPP 0.4% was the best choice of dark meat.

Keywords: nuggets, white meat, dark meat, STPP, texture profile

INTRODUCTION

Poultry meat is a well-known protein source, easy to prepare and has a high nutritive value compared to beef (red meat). Meat consumers nowadays trend to consume low calorie meat for their diet, and therefore poultry meat has a great chance to be developed.

In Indonesia one of the poultry meats which has not been developed as foodstuff is turkey meat. The National Turkey Federation (2002) stated that turkey meat has many advantages as foodstuff; easy to restructure if combine with other kinds of meat like beef or chicken.

The researchers developed new kind of nuggets using turkey meat (white meat and dark meat) as the main component.

Mountney (1989) stated that white meat of turkey consists of 34.3% protein, 7.5% fat, and 58% moisture content, while dark meat 30.5% protein, 11.6% fat, and 57% moisture content. Due to these differences, the researchers considered that there would be a significant difference of the nuggets produced on the physicochemical characteristics and sensory evaluation.

Good quality nuggets determined by the value of water holding capacity (WHC), juiciness, texture and acceptability. Therefore STPP gave a great influence to the quality of the product to achieve such properties.

The objective of this research is to find the most effective concentration of STPP to obtain good quality nuggets derived from white meat and dark meat respectively and acceptable to the consumers.

MATERIALS AND METHODS

Materials and Equipments

The turkey meat used in these experiment were Butter Ball Young Turkey received from ECFED (Education for Community Enterprise Development), Texas A & M University.

The ingredients consist of corn starch (Honig), table salt, pepper, egg, garlic and breadcrumbs bought from traditional market.

Chemicals for analysis were prepared for protein and fat analysis.

Turkey meat were minced with a Mincer (Green Power GP-10) with 53 mm diameter of the plate and 8 mm of each holes. A deep-frying pan (Sico) and freezer (Modena) were used. Analytical equipments such as Macro Kjeldhal Gerhardt, vortex (Maxi Mix II Thermolyne), centrifuge (Hettich), and Universal Testing Instrument (Lloyd/ 1000S) had been used for analytical measurements.

Experimental Design

The experiments were designed as a Nested Randomized Designed consists of two factors: part of meat; white meat (breast) (K_1) and dark meat (legs) (K_2); STPP concentration with 4 levels: 0.0, 0.2, 0.4, and 0.6%. The turkey nuggets were made based on Prinyawiwatkul, *et al.* (1997)'s formula. Of each 100 g turkey meat contains 2.5% w/w table salt, 2% w/w garlic, 0.5% w/w pepper and 10% w/w water, and 10% w/w corn-starch (Tanoto, 1994). As an example: of each 1000 g turkey meat (100%) consists of 25 g table salt, 4 g STPP (it depends on the level of concentration), 100 g water, 100 g corn starch, 22 g garlic and 5.5 g pepper.

Nuggets preparation follows as the given procedure in Figure 1. Chemical and physical examination has been done for some parameters: WHC (Li, *et al.*, 1993), pH, moisture content (AOAC, 1990), juiciness (Muchtadi and Sugijono, 1988), Texture Profile Analysis (TPA) (UTI LLOYD/ 1000S, 2002), protein content (Sudarmadji *et al.*, 1996), fat content (Sudarmadji et al., 1996), sensory evaluation by 56 panelist (performance, taste, texture, and color) (Kartika, 1988). All data were analyzed statistically using ANOVA. The difference of means between pairs was examined using Duncan's Multiple Range Test (DMRT). Level of significances was set for $P \leq 0.05$.

To determine the best treatments, Effectiveness Index (De Garmo, Sullivan and Canada, 1984) has been used.

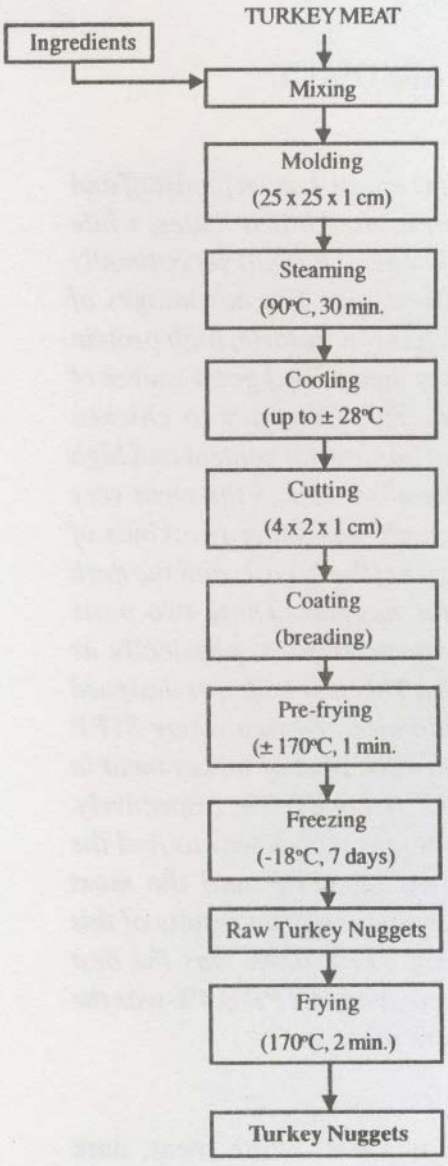

Figure 1. The Processing of Turkey Nuggets (Armaningtyas, et al., 2000, Modified)

Besides to the final product (fried nuggets), chemical and physical analysis had also been done those were: turkey meat (pH, protein, and fat); the nugget batter (pH), the steamed nuggets (pH, WHC, and juiciness), and to the frozen turkey nuggets (WHC, moisture content, juiciness, and texture profile).

RESULTS AND DISCUSSIONS

pH

Preliminary analysis had been done to the pH of raw and processed turkey meat after mixing and after steaming. The results are stated in Table 1, Table 2a. and Table 2b.

Table 1 pH of Turkey Meat

Part of Meat	pH
White meat (K_1)	5.95
Dark meat (K_2)	6.25

Table 2a. pH of Nuggets Batter from White Meat

Treatment	Mean
K_1S_1	6.08a
K_1S_2	6.45b
K_1S_3	6.83c
K_1S_4	7.07d

K_1 = white meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%
Means with different letters are significantly different (P=0.05).
Means of three replicates.

Table 2b. pH of Nuggets Batter from Dark Meat

Treatment	Mean
K_1S_1	6.29a
K_1S_2	6.71b
K_1S_3	7.19c
K_1S_4	7.81d

K2 = dark meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%
Means with different letters are significantly different (P=0.05).).
Means of three replicates.

Refers to Table 2a. and Table 2b., there were significantly difference in pH of turkey nuggets batter at each level of STPP concentration. The higher the concentration of STPP, the higher of the pH; it means that the pH was far the isoelectric point of turkey meat protein (pH of turkey meat *ca.* 5.6-6.0)

In such condition, turkey meat enlarge its capacity to bind water and made the nuggets more juicy compared to nuggets with low STPP or without STPP.

The pH value of Steam Batter Turkey Nuggets is stated in Table 3a and 3b.

Table 3a. pH of Steamed Turkey Nuggets from White Meat

Treatment	Mean
K_1S_1	6.23a
K_1S_2	6.53b
K_1S_3	6.85c
K_1S_4	7.14d

K_1 = white meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%
Means with different letters are significantly different (P=0.05).). Means of three replicates.

Table 3b. pH of Steamed Turkey Nuggets from Dark Meat

Treatment	Mean
K_1S_1	4.57
K_1S_2	4.64
K_1S_3	4.80
K_1S_4	4.90

K_2 = dark meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%
Means with different letters are significantly different (P=0.05).).
Means of three replicates.

Based on the data above, there were significant differences of pH of steamed batter turkey nuggets, both from white meat and dark meat. Steamed batter turkey nuggets perform the same pH as raw turkey nuggets. Sunarlim (1995) stated that due to the increased pH meats protein solubility will be increased, inter-protein filament space enlarge to retain water and formed a gel structure.

Water Holding Capacity

There were three sources of water in the products has to be considered regarding the value of WHC i.e. from the meat itself and from water which is added to the products. The addition of STPP caused the muscle fiber swelling and increases the capacity to bind water during steaming. WHC was increased due to the separation between actin and myosin in myofibril (Dutson and Pearson, 1987; Li *et all*, 1993).

WHC of steamed batter turkey nuggets are stated in Table 4a. and Table 4b.

Table 4a. WHC of Steamed Turkey Nuggets from White Meat

Treatment	Mean
K_1S_1	6.35a
K_1S_2	6.67b
K_1S_3	7.19c
K_1S_4	7.78d

K_1 = white meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%
Means of three replicates.

Table 4b. WHC of Steamed Turkey Nuggets from Dark Meat

Treatment	Mean
K_2S_1	4.33
K_2S_2	4.62
K_2S_3	5.00
K_2S_4	5.12

K2 = dark meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%
Means of three replicates.

Based on ANOVA there were no significantly difference (P=0.05) to WHC of steamed batter turkey nuggets. WHC were influenced by pH and therefore increases the solubility of actomyosin and weakened protein-protein interactions. The protein matrixes were opened and retain the water. The forming protein-gel matrixes were also influenced by the presence of corn-starch. Liu *et al*., (1999) stated that STPP decreased the intermolecular chain of starch and it was easy hydrated and formed starch polyphosphates (DeMan and Melnychyn, 1971) and bind the water from the meat and also from surroundings.

STPP binds Ca^{2+} of actomyosin; and therefore actin and myosin became dissociated and increased the WHC due to ionic strength of protein (Considine and Considine, 1982).

WHC of Frozen and Fried Turkey Nuggets are stated in Table 5a and Table 5b.

Table 5a. WHC of Frozen and Fried Turkey Nuggets from White Meat

Treatment	Frozen	fried	△WHC
K_1S_1	4.67	4.61	0.06
K_1S_2	4.73	4.70	0.03
K_1S_3	4.86	4.83	0.03
K_1S_4	4.89	4.84	*0.05*

K_1 = white meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%
Means of three replicates.

Table 5b. WHC of Frozen and Fried Turkey Nuggets from Dark Meat

Treatment	Frozen	fried	△ WHC
K_2S_1	4.85	4.76	0.09
K_2S_2	5.01	4.82	0.19
K_2S_3	5.03	4.85	0.45
K_2S_4	5.16	5.03	*0.13*

K_2 = dark meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%
Means of three replicates.

WHC of the frozen nuggets tend to increase in almost all treatments compared to the steamed nuggets batter, except K_1S_4, but there were no significantly difference among treatments (P=0.05).

WHC of fried nuggets decreased in all treatments of both, white and dark meat, compared

to frozen nuggets, because of some of water had been evaporated during frying, and at the same time frying-oil penetrates into the nuggets.

Egg white and breadcrumb both protect the products from extensive evaporated. Because albumin and breadcrumbs both bound the water, WHC increased and makes the products juicier.

Linear regression of WHC of all products indicates that there are strong correlation (r = 0.94-0.97) between STPP concentration and WHC. While determination coefficient indicates that the change of WHC value due to the increases of STPP (r^2 = 0.94-0.98). This means that 89.98-94.93% of the change of WHC values due to the increasing STPP concentration.

Moisture Content

Moisture content is one of the important factors to determine good quality nuggets. Statistical analysis indicates that there is no significant difference among treatments to the moisture content of frozen nuggets and fried nuggets respectively as stated in Table 6a. and Table 6b.

Table 6a. Moisture Content of Frozen and Fried Turkey Nuggets from White Meat

Treatment	Frozen %	fried %	△ WHC %
K_1S_1	55.73	48.15	7.58
K_1S_2	56.29	50.16	6.13
K_1S_3	57.03	52.95	4.08
K_1S_4	*57.61*	*53.69*	*3.92*

K_1 = white meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%
Means of three replicates.

Table 6b. Moisture Content of Frozen and Fried Turkey Nuggets from Dark Meat

Treatment	Frozen %	fried %	△ WHC %
K_2S_1	55.25	51.84	3.41
K_2S_2	57.15	52.27	4.88
K_2S_3	57.20	53.71	3.49
K_2S_4	*58.66*	*54.00*	*4.66*

K_2= dark meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%
Means of three replicates.

Moisture content of fried nuggets decreased in all treatments compared to frozen nuggets, because water evaporated during frying, and frying-oil penetrates into the nuggets. There was a tendency that the higher STPP concentration, the more water could be retained. The retained water made the product juicier. The linear regression of moister content of both products indicates that the increasing of moisture content due to the increasing of STPP concentration (r = 0.97-0.99). Determination coefficient indicates that 90.12-92.95% the change of water content due to the increasing of STPP.

Juiciness

Juiciness of nuggets is determined by pH, WHC, and moisture content. Juiciness of steamed batter and frozen nuggets are stated in Table 7a and Table 7b.

Table 7a. Juiciness of Steamed Turkey Nuggets from White Meat

Treatment	Juiciness (%)
K_1S_1	59.29
K_1S_2	59.70
K_1S_3	60.24
K_1S_4	*63.38*

K_1= white meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%
Means of three replicates.

Table 7b. Juiciness of Steamed Turkey Nuggets from Dark Meat

Treatment	Juiciness (%)
K_2S_1	58.90
K_2S_2	60.63
K_2S_3	67.90
K_2S_4	*70.17*

K2 = dark meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%
Means of three replicates.

The researchers indicate that there was a tendency that the increasing of STPP concentration, the juicier the products.

The comparison between frozen and fried nuggets is stated in Table 8a. and Table 8b.

Table 8a. Juiciness of Frozen and Fried Turkey Nuggets from White Meat

Treatment	Frozen %	fried %	△ *Juiciness* %
K_2S_1	62.91a	47.96	1496
K_2S_2	65.45a	47.97	1781
K_2S_3	67.02a	53.29	1373
K_2S_4	*71.29a*	*53.30*	*1521*

K_1 = white meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%. Means with different letters are significantly different (P=0.05).
Means of three replicates.

Table 8b. Juiciness of Frozen and Fried Turkey Nuggets from Dark Meat

Treatment	Frozen %	fried %	△ *Juiciness* %
K_1S_1	55.44a	43.32	18.08
K_1S_2	58.00a	47.30	15.64
K_1S_3	62.94a	55.30	10.68
K_1S_4	*74.42b*	*55.96*	*18.46*

K_2 = dark meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%. Means with different letters are significantly different (P=0.05).
Means of three replicates.

Based on the data above, STPP of different concentration is not significantly difference to the juiciness of frozen nuggets, except on K_1S_4, but there were no significantly difference on all treatments to the dark meat. In white meat of frozen nuggets, 0.6% STPP able to retain water, and increases the juiciness of the products. Contrary, at the same concentration of STPP has no significant effect to the juiciness in dark meat turkey nuggets compared to other treatments.

Juiciness decreases due to frying of all treatments in both white meat turkey nuggets and dark meat turkey nuggets. Water of the products evaporated during frying.

Texture Profile

Texture profile of turkey nuggets were analyzed using Lloyd Instrument. Texture profile analysis was applied to three main characteristics: hardness, deformation, and cohesiveness.

Texture of a product is form by development of gel matrix protein, starch and water during mixing and cooking.

Hardness.

Hardness is one of the most characteristics of acceptability of nuggets. Hardness of white and dark meat of frozen turkey nuggets is stated in Table 9a. and Table 9b. and of fried turkey nuggets is stated in Table 10a and Table 10b.

Table 9a. Hardness of Frozen Turkey Nuggets from White Meat

Treatment	*Hardness (N)*
K_1S_1	22.76a
K_1S_2	27.48b
K_1S_3	27.58b
K_1S_4	*29.15b*

K_1= white meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%. Means with different letters are significantly different (P=0.05).
Means of three replicates.

Table 9b. Hardness of Frozen Turkey Nuggets from Dark Meat

Treatment	*Hardness (N)*
K_2S_1	15.65a
K_2S_2	15.89a
K_2S_3	19.58b
K_2S_4	*20.11b*

K2 = dark meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%. Means with different letters are significantly different (P=0.05).
Means of three replicates.

Table 10a. Hardness of Fried Turkey Nuggets from White Meat

Treatment	*Hardness (N)*
K_1S_1	24.79a
K_1S_2	33.30b
K_1S_3	34.19b
K_1S_4	*36.09b*

K_1= white meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%. Means with different letters are significantly different (P=0.05).
Means of three replicates.

Table 10b. Hardness of Fried Turkey Nuggets from Dark Meat

Treatment	*Hardness (N)*
K_2S_1	13.89a
K_2S_2	15.78a
K_2S_3	18.44a
K_2S_4	*18.68a*

K2 = dark meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%. Means with different letters are significantly different (P=0.05).
Means of three replicates.

Hardness of frozen and fried turkey nuggets derived from white meat without STPP (K_1S_1) shows significantly difference to other treatments. But there is no significantly difference on hardness among 0, 0.2, 0.4, and 0.6% STPP of turkey nuggets derived from dark meat. This differences due to the relatively high content of collagen in the meat and influenced the hardness (Daum-Thunberg, Foegeding and Ball, 1992).

The addition of STPP increased the hardness of the products because of the development of gel matrix starch-protein, and developed well-structured products.

Steaming caused myofibril protein gelation, and opened the peptide chain and bound the hydrated water. The immobilized free water of muscle structural protein (actins, myosin, and tropomyosin) interacts with starch and forms a protein-starch gel-matrix that is more strength.

Deformation.

The deformation value indicates the percentage of destruction of upper-layer of the products. When the deformation value is near 100, it means that the product is more solid, and vice versa.

Deformation values of frozen and fried turkey nuggets derived from white and dark meat respectively are stated in Table 11a. and Table 11b., Table 12a. and Table 12b.

Table 11a. Deformation of Frozen Turkey Nuggets from White Meat

Treatment	*Deformation*
K_1S_1	49.95a
K_1S_2	61.04b
K_1S_3	62.37b
K_1S_4	*63.30b*

K_1= white meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%. Means with different letters are significantly different (P=0.05).
Means of three replicates.

Table 11b. Deformation of Frozen Turkey Nuggets from Dark Meat

Treatment	*Deformation*
K_2S_1	59.03a
K_2S_2	59.56a
K_2S_3	60.95a
K_2S_4	*62.11a*

K2 = dark meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%. Means with different letters are significantly different (P=0.05).
Means of three replicates.

Table 12a. Deformation of Fried Turkey Nuggets from White Meat

Treatment	*Deformation*
K_1S_1	41.80a
K_1S_2	60.77b
K_1S_3	61.17b
K_1S_4	*61.30b*

K_1= white meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%. Means with different letters are significantly different (P=0.05).
Means of three replicates.

Table 12b. Deformation of Fried Turkey Nuggets from Dark Meat

Treatment	*Deformation*
K_2S_1	52.35a
K_2S_2	56.36b
K_2S_3	58.66b
K_2S_4	*59.29b*

K2 = dark meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%. Means with different letters are significantly different (P=0.05).
Means of three replicates.

Based on the data above, both frozen nuggets and fried nuggets derived from white without STPP respectively, are significantly difference to nuggets with STPP. It means that nuggets without STPP have soft and disaggregate structure compared to the nuggets with STPP.

While frozen nuggets derived from dark meat are not significantly differences among treatments. It means that STPP has no influenced to the deformation of the structure of the nuggets. The researchers suspect that in frozen nuggets derived from dark meat occurs interactions among components has great influenced. But there are significantly differences between nuggets without STPP and with STPP in fried nuggets from dark meat. Statistical analysis shows that there are positive correlations between concentration of STPP and deformation value.

Cohesiveness.

Cohesiveness of a nugget indicates the strength of interactions among components to perform a specific structure of a product (Moskowitz, 1987). Moreover, Rosenthal (1999) stated that cohesiveness shows the ability of a product to hold the structure at the second pressure after the first pressure had been given to a given square width. The value or percentage of cohesiveness is the width of an area of the second pressure divided to the width of the first pressure.

The percentage of cohesiveness of frozen turkey nuggets and fried turkey nuggets derived from white meat and dark meat respectively are stated in Table 13a, 13b, 14a, and 14b.

Table 13a. Cohesiveness of Frozen Turkey Nuggets from White Meat

Treatment	*Cohesiveness (%)*
K_1S_1	48.12
K_1S_2	51.57
K_1S_3	52.50
K_1S_4	*57.46*

K_1= white meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%. Means with different letters are significantly different (P=0.05).
Means of three replicates.

Table 13b. Cohesiveness of Frozen Turkey Nuggets From Dark Meat

Treatment	*Deformation*
K_2S_4	51.79
K_2S_3	53.74
K_2S_2	54.60
K_2S_1	*55.89*

K2 = dark meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%. Means with different letters are significantly different (P=0.05).
Means of three replicates.

Table 14a. Cohesiveness of Fried Turkey Nuggets from White Meat

Treatment	*Cohesiveness (%)*
K_1S_1	34.55a
K_1S_2	55.45b
K_1S_3	62.01b
K_1S_4	*62.56b*

K_1= white meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%. Means with different letters are significantly different (P=0.05).
Means of three replicates.

Table 14b. Cohesiveness of Fried Turkey Nuggets from Dark Meat

Treatment	*Cohesiveness (%)*
K_2S_1	46.51a
K_2S_2	50.47b
K_2S_3	53.02b
K_2S_4	*53.79b*

K2 = dark meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%. Means with different letters are significantly different (P=0.05).
Means of three replicates.

In frozen turkey nuggets from white and dark meat STPP has no significantly different to the cohesiveness among all treatments. But in fried turkey nuggets STPP gave it's influenced to the products compared to nuggets without STPP. The existing of STPP promotes the interactions between components especially in the forming of protein-gel matrix, starch and water, and increased the cohesiveness and juiciness of the products.

Sensory evaluation

Sensory evaluation had been done to know the acceptability of the products to the consumers through hedonic test. Sensory evaluation consists of: performance preference, taste preference, texture (mouth feel), and color (coating part). The range of score is between 1 (most dislike) to 9 (most like), where is 5 (neutral).

Performance. There was no significantly difference of the performance of the turkey nuggets derived from white meat and dark meat respectively between treatments. The means of the preference score is stated in Table 15a. and Table 15b.

Table 15a. Performance of Fried Turkey Nuggets from White Meat

Treatment	*Performance*
K_1S_1	5.90a
K_1S_2	6.10a
K_1S_3	6.14a
K_1S_4	*6.20a*

K_1= white meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%. Means with different letters are significantly different (P=0.05).
Means of three replicates.

Table 15b. Performance of Fried Turkey Nuggets from Dark Meat

Treatment	*Performance*
K_2S_1	3.40a
K_2S_2	3.63a
K_2S_3	3.77a
K_2S_4	*3.95a*

K2 = dark meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%. Means with different letters are significantly different (P=0.05).
Means of three replicates.

Based on the data above, turkey nuggets derived from dark meat were least like (3.40-3.90) than from white meat (5.90-6.20). This could be understood that dark meat has more collagen rather than white meat. White meat has a tender texture, but least juicy compared to dark meat (Penfield and Campbel, 1990). Panelists like nuggets from white meat and 0.6% STPP (K_1S_4) because of the increasing of WHC and the products were juicier. Contrary, turkey nuggets derived from dark meat contains more myoglobin that makes the color darker.

Taste preferences. Taste is one of the most important food attributes. Taste preference test of

fried turkey nuggets derived from white meat and dark meat is stated in Table 16a. and Table 16a.

Table 16a. Taste Preference of Fried Turkey Nuggets from White Meat

Treatment	*Taste Preference*
K_1S_1	4.27a
K_1S_2	4.99b
K_1S_3	5.21b
K_1S_4	*5.52b*

K_1= white meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%. Means with different letters are significantly different (P=0.05).
Means of three replicates.

Table 16b. Taste Preference of Fried Turkey Nuggets from Dark Meat

Treatment	*Taste Preference*
K_2S_1	5.35a
K_2S_2	5.39a
K_2S_3	5.42a
K_2S_4	*5.67a*

K2 = dark meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%. Means with different letters are significantly different (P=0.05).
Means of three replicates.

Fried turkey nuggets derived from white meat without STPP (K_1S_1) and with 0.2% STPP (K_1S_2) were least liked because white meat has low fat content, and therefore least juicy compared to 0.4% and 0.6% STPP which is more acceptance by the panelist.

Adversely, fried turkey nuggets derived from dark meat has no significantly difference to taste of all treatments because of the relatively high fat content in the dark meat and can hold the juiciness of the products. Fat gave a lubricant effect during mastication. While STPP contributes in binding water through starch and protein, and it gave specific taste to the panelist.

Texture preferences.

Texture preference represents the mouth feel characteristics of the products. Texture preference test of fried turkey nuggets derived from white meat and dark meat is stated in Table 17a and Table 17b.

Table 17a. Texture Preference of Fried Turkey Nuggets from White Meat

Treatment	*Texture Preference*
K_1S_1	3.84a
K_1S_2	3.86a
K_1S_3	4.16a
K_1S_4	*5.96b*

K_1= white meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%. Means with different letters are significantly different (P=0.05).
Means of three replicates.

Table 17b. Texture Preference of Fried Turkey Nuggets from Dark Meat

Treatment	*Taste Preference*
K_2S_1	5.03a
K_2S_2	5.12a
K_2S_3	5.16a
K_2S_4	*5.63a*

K2 = dark meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%. Means with different letters are significantly different (P=0.05).
Means of three replicates.

Texture of fried turkey nuggets derived from white meat with 0.2%, 0.4%, and 0.6% STPP respectively were relatively disliked by the panelist. STPP caused the products more tough and hard and not easily to masticate. While fried nuggets without STPP has an acceptable texture, tender, although it was less juicy.

Texture of friend turkey nuggets derived from dark meat was acceptable by the panelist. There were no significantly differences among treatments.

Color preferences. Color gave an important characteristic of food to attract consumers. The colors of fried turkey nuggets derived from white meat were more acceptable to the panelist compared to the dark meat. The result of color preference test is stated in Table 18a. and Table 18.b.

Table 18a. Color Preference of Fried Turkey Nuggets from White Meat

Treatment	*Color Preference*
K_1S_1	6.10a
K_1S_2	6.22a
K_1S_3	6.34a
K_1S_4	*6.46a*

K_1 = white meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%. Means with different letters are significantly different (P=0.05).
Means of three replicates.

Table 18b. Color Preference of Fried Turkey Nuggets from Dark Meat

Treatment	*Taste Preference*
K_2S_1	3.78a
K_2S_2	3.98a
K_2S_3	3.99a
K_2S_4	*4.30a*

K2 = dark meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%. Means with different letters are significantly different (P=0.05).
Means of three replicates.

Sensory evaluation to all factors (performance, taste, texture and color) indicates that turkey nuggets were not accepted due to the unfamiliar product compared to chicken nuggets that is more popular.

Effectiveness Index

Effectiveness index shows the properly treatment to get the best-fried turkey nugget based on all parameter. Each parameter has a rank according to the consumers' expectation: performance (1); taste (1); texture (1); color (0.9); hardness (0.9); deformation (0.9); cohesiveness (0.9); pH (0.8); WHC (0.8); juiciness (0.8), and moisture content (0.7).

The best-fried turkey nuggets were obtained from white meat with 0.6% STPP, and from dark meat with 0.4% STPP.

Nutritive evaluation

The best-fried turkey nuggets were analyzed to know the nutritive value focused on protein and fat content respectively, as stated in Table 19.

Table 19 Protein and Fat Analysis of the Best Fried Turkey Nuggets

Components	*Treatments*			
	Fresh Meat		The Best Nuggets	
	White	Dark	K_1S_4	K_2S_3
Protein (%)	14.50	11.88	13.89	9.01
Fat (%)	1.74	2.93	6.67	8.73

K2 = dark meat; S_1=STPP 0%, S_2=STPP 0.2%, S_3=STPP 0.4%, S_4=STPP 0.6%.
N factor for turkey meat (white) = 3.9; and for dark meat 3.5 (Church and Wood, 1981)

Protein content in fresh white meat decreased 0.61% during processing; while in fresh dark meat decreased 2.87%. The decreasing of protein content mostly due to mincing, and few of water from the meat has been drained. But due to the addition of STPP before mincing, water was drained minimally. Phosphate ion gave a significant role in this process.

Fresh dark meat loss their protein content significantly during processing, because dark meat has much collagen and difficult minced, and therefore few of them were rejected.

Fat content of fresh white meat increased 4.93% during processing; while in fresh dark meat decreased

5.80%. The increasing of fat content of both turkey nuggets from white meat and dark meat is due to the frying process. The product has been frying two times, and this frying oil significantly contribute the fat content of the products, especially the products have coated with egg-white and breadcrumbs which is oil-absorbance.

CONCLUSIONS

STPP influences the pH, hardness, deformation value, performance, taste, texture, and color of turkey nuggets derived from white and dark meat respectively. There is no significantly difference among STPP concentration to the WHC, moisture content, juiciness, and cohesiveness.

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