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Development of low-fat chicken nuggets

(Penghasilan nuget ayam kurang lemak)

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Key words: chicken, low-fat, nuggets

Abstrak

Daging dada ayam tanpa kulit dan pelbagai pengganti lemak digunakan untuk menghasilkan nuget ayam kurang lemak. Kandungan daging dalam nuget berjulat antara 70% dan 84.5%. Pengganti lemak yang dinilaikan ialah kanji ubi terubahsuai (MTS), tepung gandum (WF) dan karaginan (CA). Formulasi yang digunakan juga mengandungi air tambahan sebanyak 25% bagi sampel MTS dan WF manakala 13% bagi sampel CA. Hasilan dinilai dari segi rasa. Komposisi, kehilangan semasa memasak, warna dan analisis profil tekstur hasilan ditentukan dan dibandingkan antara sampel. Nilai ini juga dibandingkan dengan nilai daripada hasilan yang mengandungi 88.5% daging (HM) dan 10% air tambahan serta sampel komersial (CM). Hasil daripada penilaian menunjukkan bahawa pada amnya, nilai deria sampel MTS lebih tinggi sementara sampel WF mendapat penilaian yang paling rendah walaupun masih boleh diterima. Kandungan lemak bagi nuget yang bersalut serbuk roti sebelum dimasak berjulat antara 0.26% bagi sampel WF dan 30.4% bagi sampel CM. Nilai putih *(L*)* bagi kesemua sampel lebih kurang sama (74–75). Perbezaan yang ketara terdapat pada kehilangan semasa memasak. Nilai ini ialah1.0% bagi sampel MTS manakala 13.3% bagi sampel CM. Analisis profil tekstur tidak menunjukkan perbezaan yang nyata bagi sifat kelekatan dan kekenyalan antara sampel yang dinilaikan.

Abstract

Skinless chicken breast meat and various fat replacers were used to produce low-fat chicken nuggets. The meat content ranged from 70% to 84.5%. Fat replacers evaluated were modified tapioca starch (MTS), wheat flour (WF) and carrageenan (CA). The formulation also contained 25% added water in the MTS and WF samples, and 13% in the CA samples. The products were evaluated organoleptically. Their composition, cooking loss, colour and texture profile analysis were determined and compared against each other as well as those made with 88.5% meat (HM) and 10% added water, and a commercial sample (CM). Results of the sensory evaluation showed that scores were generally higher for the MTS sample while the WF sample had the lowest score. The fat content of the raw battered and breaded samples ranged from 0.26% in the WF sample to 30.4% in the CM sample. All the samples had similar whiteness *(L*)* value (74–75). On the other hand, there were substantial differences in cooking loss, ranging from about 1.0% to 13.3% in the MTS and CM samples respectively. Texture profile analyses indicated no significant differences in the cohesiveness and springiness among the samples evaluated.

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Introduction

In recent years, consumers have become more health conscious. There is now a trend towards consuming processed meat which are low in fat, salt and cholesterol. Such demand has prompted more research on the development of a wider range of meat products with low or reduced fat with more processors showing greater interest to produce and market such products.

Traditionally, processed meat products have high fat content, up to 30% (Keeton 1993), as fat provides sensory characteristics such as flavour, juiciness and mouthfeel to the products. By lowering the fat content, the effect of some of these characteristics will be reduced and the products may become unacceptable. Studies on restructured chicken steaks have shown that products made with higher fat content were more acceptable (Chuah 1994). According to Claus et al. (1989) and Claus et al. (1990), reduced-fat products can be produced by using leaner meats, adding water or other non-meat ingredients. However, increasing the lean meat content through reducing fat will result in a firmer, more rubbery and less juicy product besides increasing the production cost (Hand et al. 1987). Increased cooking loss and purge in bologna have been reported by Gregg et al. (1993) when substituting water for fat. Keeton (1993), however, has suggested that some combinations of fat replacers that mimic the mouthfeel and characteristics of fat offer potential for the development of low-fat meat products. Such replacers could be protein-based (e.g. wheat flour, soya flour, soya concentrate and soya isolate), carbohydrate-based (e.g. carrageenan and starch) and synthetic fat substitutes (e.g. polydextrose and olestra). The development of meat products with low or reduced fat is the result of increased consumer demand for healthier products. However, in order to succeed, processors must be able to substitute fat with non-meat ingredients which are low in calories yet give the desired sensory characteristics offered by fat. Such products must not only be cost effective but also have at least the same or better shelf life and other quality aspects. Although currently several non-meat ingredients are available for use as fat replacer, work needs to be carried out to identify other processes which will further improve the organoleptic and technological advances.

As such, this study was carried out to compare the physical and chemical characteristics of chicken nuggets containing either modified tapioca starch (MTS), wheat flour (WF), carrageenan (CA) with a high meat sample (88.5% meat and 10% added water, HM) and a commercial sample (CM).

Materials and methods

Processing method

Frozen skinless chicken breast meat was used for the production of the chicken nuggets *(Figure 1).* Frozen skinless chicken breast meat was flaked. Salt and sodium tripolyphosphate (STPP) were then added to the meat and blended to extract out the salt-soluble protein from the meat to obtain a sticky meat mass. Ice water (13–25%) was then added followed by fat replacer (modified tapioca starch, wheat flour or carrageenan) and spices. Blending continued to obtain an even mixing. The meat mass was then lightly frozen to facilitate the forming of the nuggets using a forming machine. Using commercially available batter flour and breadcrumbs, the nuggets were battered and breaded before freezing. Depending on the type of mould used, the size, shape and weight of the nuggets formed would vary.

Sensory evaluation

The fried products were evaluated for their cohesiveness, flavour, texture, juiciness, tenderness and overall acceptability by a taste panel of 10 members picked from a pool of select panelists, using a 9-point hedonic scale, where 9 represents the highest score.

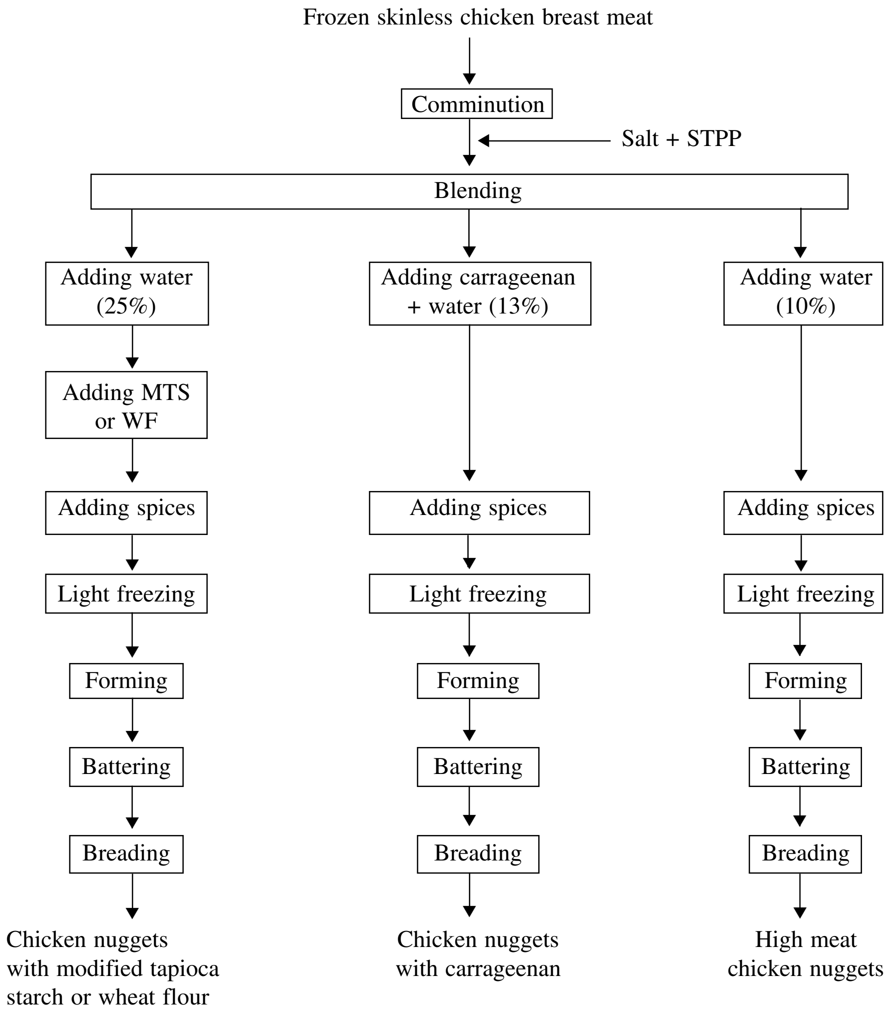

Figure 1. Processing of chicken nuggets

Chemical analysis

The fat, moisture, protein, ash and crude fibre contents of both the raw and fried samples were analysed in quadruplicate using the methods by Egan et al. (1981).

Cooking loss

The samples were pressure fried for 1.5 min at 180 °C. Cooking loss was determined by the loss in weight before and after frying.

Colour determination

The colour of the internal part of the fried products was measured with a Minolta chroma meter (model CR 300) after the products were cut longitudinally.

Texture profile analysis

Texture profile analysis (TPA) of the fried products was determined by using a texture analyser Stevens Fernell (model QTS 25). The samples were evaluated on their hardness, chewiness, gumminess, cohesiveness and springiness. All the fried samples were cooled to room temperature prior to the textural determination, using two-cycle compression with a speed of 30 mm/min.

Statistical analysis

Results of the sensory evaluation and the TPA were analysed using the ANOVA and Duncan Multiple Range Test (DMRT). Standard deviations on the results for the chemical composition of the raw and fried reduced-fat nuggets as well as for the cooking loss and whiteness values for the fried samples were determined.

Results and discussion

Results of the sensory evaluation indicate that all five samples were acceptable *(Table 1).* No significant differences were seen among the samples in cohesiveness, texture and overall acceptability. However, there was a significant difference (p <0.05) in flavour where the CM sample had higher score and differed significantly from the others. On the other hand, the sample with modified tapioca starch (MTS) was significantly more tender and juicy (p <0.05) compared to the HM, CM and WF samples. A significant difference in juiciness was also noted between the HM and CA samples.

In general, nuggets made with the addition of MTS were found to be more acceptable than the others, especially in juiciness and tenderness. However, the CM sample had a significantly higher score in flavour probably due to its higher fat content of about 30%. As can be seen in *Table 2*, samples with fat replacers and the HM sample had much lower fat content than the CM sample before and after frying. Due to the large amount of water added to the samples with fat replacer and a lesser amount to the HM sample, the moisture content of the raw battered and breaded samples was much higher (61–70%) than the CM sample. The moisture content of the samples with fat replacer was still quite high, ranging from about 55% to 57% even after frying. Cooking loss was recorded in all samples *(Table 3).* However, cooking loss of about 13.33% in the CM sample was the

Table 1. Mean scores of six sensory attributes of low-fat chicken nuggets

Sample	Cohesiveness	Flavour	Texture	Juiciness	Tenderness	Overall acceptability
MTS	7.40a ± 0.07	7.00b ± 0.94	7.40a ± 0.70	7.50a ± 0.70	7.90a ± 0.57	7.30a 0.82
CA	7.50a ± 0.85	7.10b ± 1.13	7.10a ± 0.74	7.20ab ± 1.03	7.25b ± 0.86	7.05a ± 0.90
WF	7.00a ± 0.82	6.60b ± 1.08	6.90a ± 0.99	6.80bc ± 0.79	7.10b ± 0.99	6.55a ± 1.07
HM	7.20a ± 0.79	7.10b ± 0.74	7.00a ± 0.94	6.60c ± 0.84	7.10b ± 0.99	6.95a ± 0.83
CM	7.20a ± 0.79	7.90a ± 0.57	7.10a ± 0.88	6.70bc ± 0.95	6.95b ± 1.07	7.30a ± 1.06

Mean values in each column with different letter differ significantly (p <0.05)
MTS = modified tapioca starch, CA = carrageenan, WF = wheat flour,
HM = high meat, CM = commercial

Table 2. Chemical composition of raw and fried low-fat chicken nuggets

Sample		Fat (%)	Moisture (%)	Protein (%)	Ash (%)	Crude fibre (%)
MTS	Raw	0.77 ± 0.14	69.76 ± 0.19	14.33 ± 0.88	1.67 ± 0.02	0.61 ± 0.06
	Fried	24.16 ± 1.22	55.53 ± 0.18	13.52 ± 1.40	1.81 ± 0.06	0.59 ± 0.23
CA	Raw	1.16 ± 0.55	66.22 ± 1.59	15.62 ± 2.82	1.97 ± 0.12	0.29 ± 0.01
	Fried	24.52 ± 0.83	56.77 ± 0.25	18.11 ± 0.42	2.00 ± 0.10	1.44 ± 1.02
WF	Raw	0.26 ± 0.08	70.39 ± 5.58	14.91 ± 1.00	1.82 ± 0.02	0.31 ± 0.17
	Fried	23.62 ± 0.64	57.86 ± 3.66	14.78 ± 1.39	1.86 ± 0.03	0.33 ± 0.20
HM	Raw	1.81 ± 0.15	61.05 ± 2.72	14.23 ± 1.53	1.96 ± 0.02	0.14 ± 0.02
	Fried	24.25 ± 1.06	52.12 ± 3.73	16.68 ± 2.11	1.94 ± 0.14	0.60 ± 0.37
CM	Raw	30.40 ± 0.40	55.26 ± 0.39	12.04 ± 0.87	1.44 ± 0.06	2.72 ± 0.09
	Fried	34.04 ± 0.12	43.29 ± 0.40	13.23 ± 0.87	1.85 ± 0.20	2.31 ± 0.46

highest among the samples. The high moisture retention and low cooking loss indicated that there was a good emulsion formation in the products. It could also be implied that the fat replacers used also have high water retention capability.

The whiteness value *(L*)* of the products with fat replacers did not differ much from those of the HM and CM samples. This shows that the addition of the fat replacers did not affect the colour of the products, as the colour of the fat replacers used was generally white. Colour is a very important attribute of the chicken nuggets as consumers have a perception that chicken nuggets must be white. However, commercial products sometimes contain a small amount of thigh meat which has a darker colour. The use of thigh meat which is cheaper than breast meat, lowers the production cost of chicken nuggets.

Texture profile analysis *(Table 4)* showed that the HM sample had the highest hardness value and was significantly different (p <0.05) from the other samples, probably due to its high meat content. On the other hand, the MTS sample was the least firm and was significantly different (p <0.05) from the others. Being the hardest, the HM sample also had the highest chewiness and gumminess values which were significantly different (p <0.05) compared to the others, with the MTS sample being the least chewy and gummy, and also significantly different (p <0.05) from the rest of the samples. However, no significant differences were noted for cohesiveness and springiness among the samples. Thus, with the addition of fat replacers and high water content, the resultant products would be softer than the HM sample.

Table 3. Mean scores of cooking loss and whiteness value *(L*)* of low-fat chicken nuggets

Sample	Cooking loss (%)	*L** value
MTS	0.95 ± 0.35	75.14 ± 0.87
CA	3.95 ± 1.71	74.27 ± 0.95
WF	1.32 ± 0.66	75.28 ± 1.05
HM	2.54 ± 1.14	74.25 ± 1.53
CM	13.33 ± 1.78	74.91 ± 0.42

Conclusion

Results obtained from the study showed that acceptable low-fat chicken nuggets can be produced using the currently available fat replacers. The degree of acceptability of these nuggets depends on the type of fat replacer used. Although it is possible to reduce the fat content of the raw chicken nuggets substantially, current methods of frying would result in reduced-fat rather than low-fat nuggets. However, the fat content in the final product was still about 10% lower than that of commercial sample.

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Table 4. Texture profile analysis of low-fat chicken nuggets

Sample	Hardness (g)	Chewiness (gmm)	Gumminess (g)	Cohesiveness (ratio)	Springiness (mm)
MTS	154.7d ± 24.96	241.62d ± 41.62	130.2d ± 21.92	0.84a ± 6.13	1.85a ± 0.05
CA	308.3bc ± 9.74	467.2bc ± 27.93	257.6bc ± 12.60	0.84a ± 2.63	1.78a ± 4.70
WF	367.3b ± 33.48	565.3b ± 34.08	307.8b ± 25.4	0.84a ± 2.13	1.84a ± 4.32
HM	467.0a ± 38.08	738.0a ± 91.95	394.8a ± 32.91	0.85a ± 1.14	1.86a ± 7.72
CM	256.3c ± 22.46	415.4c ± 29.40	222.1c ± 15.42	0.87a ± 1.63	1.87a ± 1.41

Mean values in each column with different letter differ significantly (p <0.05)

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