Sains Malaysiana 40(10)(2011): 1165–1172

Cornsilk (*Zea mays* Hairs) Improves Nutrient, Physical Traits without Affecting Sensory Properties of Chicken Patties

(Sutera Jagung (Rambut *Zea mays)* Memperbaiki Nutrien, Ciri-Ciri Fizikal Tanpa Mengubah Sifat-Sifat Penilaian Deria Burger Ayam)

W.I. Wan Rosli*, A.R. Nurhanan, M.A. Solihah & S.S.J. Mohsin

ABSTRACT

The proximate analyses, physical traits and sensory properties of chicken patties incorporated with different levels of cornsilk dietary fibre were studied. The patties were formulated with 2%, 4% and 6% dried ground cornsilk. The protein content increased in line with the cornsilk level in both raw and cooked chicken patties. Cooked chicken patties incorporated with 6% cornsilk showed the highest protein concentration at 28.42% and the lowest fat concentration at 14.60%, respectively. All cooked patty samples recorded moisture content ranging from 42.73-46.40%. Patty formulated with 6% cornsilk recorded the highest cooking yield at 83.03%. Cornsilk fibre has been successful in improving cooking yield and in retaining moisture and fat of chicken patties. The addition of cornsilk fibre does not change the sensory properties and the acceptability of chicken patties.

Keywords: Chicken patties; cornsilk; proximate composition; sensory evaluation

ABSTRAK

Analisis proksimat, ciri-ciri fizikal dan sifat-sifat penilaian deria terhadap burger ayam yang ditambah dengan kandungan sutera jagung yang berbeza telah dikaji. Burger ayam telah diformulasikan dengan 2%, 4% atau 6% sutera jagung kering yang dikisar. Kandungan protein meningkat selari dengan peningkatan kandungan sutera jagung dalam burger ayam mentah dan yang digoreng. Burger ayam yang digoreng yang mengandungi 6% sutera jagung merekodkan kandungan protein paling tinggi iaitu sebanyak 28.42%, dan lemak yang terendah iaitu 14.60%. Semua sampel burger merekodkan kandungan lembapan antara 42.73-46.40%. Burger ayam yang diformulasikan dengan 6% sutera jagung merekodkan hasil memasak yang tinggi iaitu 83.03% berbanding perlakuan lain. Serat dietari sutera jagung berkesan dalam mengekalkan hasil memasak, lembapan dan lemak burger ayam. Penambahan sutera jagung tidak mengubah ciri-ciri sensori dan penerimaan pengguna terhadap burger ayam.

Kata kunci: Burger ayam; komposisi proksimat; penilaian deria; sutera jagung

Introduction

Globally, the consumption of chicken increased tremendously and parallel with its production. The chicken production is increased by 3% in 2010 to reach 73.7 million metric tons. This increment is influenced by the strength and sustainability of the upturn in the global economy (Clement 2010). Chicken consumption was reported to increase from 40 pounds per year to 62.5 pounds per year per person while pork consumption has remained stable at about 47.8 pounds per year (USDA 2002). Overall, per capita consumption of poultry and red meat has not changed significantly, but when beef, pork, and chicken were examined separately, beef appears to be losing market share to chicken. This result clearly showed that US consumers do not perceive beef as being competitive with chicken in terms of offering low-fat and low cholesterol product lines. A recent study showed that consumer concerns regarding beef were related to cholesterol, calorie content, artificial ingredients, convenience characteristics (microwaveable and storage), how beef is displayed in the store and price (too expensive) (Menkhaus & Colin 1993).

The reason for the increase in poultry consumption may be due to the poultry industry's catering to consumers through its emphasis on producing value-added convenient products. The poultry industry has been more responsive to the changes in consumer lifestyles than the beef industry by providing products that address health and convenience concerns. Only 34.7% of total processed broilers in 1974 were sold as cut up pieces, a value-added and a more convenient product compared to whole roasters. By 1989, the share of cut up chicken grew to over 60% and increased to 65.4% in 1999. The proliferation of chicken products has also increased the demand for chicken, and, in turn, has reduced the market share of other meats such as beef and pork. Much of the positive perception enjoyed by chicken is as much the result of packaging, positioning and product form and pricing. Chicken is an entirely different product in the eyes of consumers than it was 20 years ago, while beef's image is virtually unchanged (Resurreccion 2004).

Chicken patties are amongst the most popularly consumed processed meat products in Malaysia and other parts of the world. Some of the reasons for such wide popularity are affordable cost, availability in different tastes and longer shelf life. As more evidence concerning the benefits and risks associated with dietary nutrients are emerging in both the scientific field and the mass media, today's consumers are more informed on the link between health and diet. Levels of saturated fat and cholesterol have been a major concern, resulting in meat products becoming the subject of scrutiny by nutritional, medical, and consumer groups (Chizzolini et al. 1999; Colmenero 1996; Ollberding 2008; Resurreccion 2004).

The application of natural palm based fats which contained no cholesterol in processed meat products was first ventured as alternatives to animal fats in chicken nuggets and beef burgers (Babji et al. 2001). Babji et al. (2001) also found that there were no significant differences in cooking losses, texture, juiciness, oiliness and overall acceptance between the burgers prepared with palm fats and beef fat. Shiota et al. (1995) reported that beef patties containing 'Bungo' beef received the highest scores with 20% palm oil and palm mid-fraction. Recently, we found that the application of red palm oils in beef frankfurter improved vitamin E, reduced cholesterol but not carotenes in beef frankfurters (Wan Rosli et al. 2010; 2011).

Attention in addition of meat products with legume and oilseed derivatives is based primarily on the potential to reduce product cost (Mcwatters 1990) while maintaining nutritional and sensory qualities of end products that consumers expect. Reduction of fat in processed ground meat products presents a number of difficulties in terms of appearance, flavor and texture. Manufacturers have tried several modifications in an effort to compensate the unfavorable effects of reducing the fat level. These modifications include the use of non-meat ingredients that could help to convey desirable texture and, more importantly, improve water-holding capacity (Ako 1998). In this regard, researchers have suggested that carbohydrates and fibre have been successful in improving cooking yield, reduced formulation cost and enhanced texture (Jimenez 1996; Keeton 1994)

Extensive studies have been done on the use of various types of fat replacer and plant dietary fibre in processed meat and poultry products in attempts to increase dietary fibre and lowering of fat content. The effect of utilization of tapioca starch, oat fibre (Desmond et al. 1998; Dongowski et al. 2003; El-Magoli et al. 1996; Inglett et al. 2005; Yilmaz & Daglioglu 2003), cereal and fruit fibres (Hecker et al. 1998; Garcia et al. 2002; Mansour & Khalil 1999) and whey protein (El-Magoli et al. 1996) on the physical characteristics and sensory properties of low-fat beef patties has been studied previously. The addition of pea fiber concentrate (PFC) and wheat fiber concentrate (WFC) in beef burger formulation improves their cooking properties, i.e., increases the cooking yield and decreases the shrinkage, and minimizes production cost without ruin of sensory properties (Besbes et al. 2008). Recently, researchers found that dietary grape pomace concentrate and grape antioxidant dietary fibre could be successful in retarding lipid oxidation of chilled and long-term frozen stored of raw and cooked chicken patties (Sayago-Ayerdi et al. 2009). In another study, antioxidative effect of added tea catechins on susceptibility of cooked red meat, poultry and fish patties to lipid oxidation has been reported earlier (Tanga et al. 2001).

The present study focuses on the effect of utilizing cornsilks dietary fibre (*Zea mays* L.) in processed food products. Cornsilk or corn hairs are referred to the collection of stigmas of the maize female flowers. The cornsilk threads are normally discarded during the processing of baby corn as a vegetable. Statistical information on baby corn production is limited because many producing countries either do not report baby corn production or include it within the sweet corn category. Traditionally, infusion of cornsilks had been used as a therapeutic remedy. The ailments include inflammation of the urinary bladder and prostate and treatment for irritation of the urinary system. To date, numerous commercially viable traditional products prepared from cornsilk are available (El-Ghorab et al. 2007). Cornsilk contains various chemicals, including proteins, vitamins, alkaloids, tannins and mineral salts, carbohydrates, steroids and flavonoids as well as other volatile chemicals (Kwag et al. 1999).

The pharmacological and biological activities of cornsilk constituents are well reported in the literature. These include antibiotic activity of glycoside maysin (Maksimovic & Kovacevic 2003), attractant activity toward corn earworm (Guevara et al. 2000), purification and characterization of anticoagulant (Sang-Kyu & Hye-Seon 2004). Other than these reported activities, some local species are consumed as tea, powdered as food additive and flavorings agents in several regions of the world (Koedam 1986; Yesilada & Ezer 1989). However, the utilization of consilk in any meat based product has never been studied.

Thus, in this work we investigated the physical characteristics and sensory properties of chicken patties with added cornsilk dietary fibre.

Materials and Methods

Preparation of Cornsilk

Fresh young *Zea mays* were harvested from Pantai Cahaya Bulan, a coastal district area of Kota Bharu, in the state of Kelantan, Malaysia. Upon arrival in the Nutrition Laboratory of the School of Health Sciences, Universiti Sains Malaysia, the hairs of the young corns or cornsilks were detached from the fruit stalks, cleaned and washed with distilled water. The fresh cornsilks collected were then oven dried at 50°C until brownish threads were obtained. The brownish dried cornsilks were ground into powder form and kept in screw cap bottle at 4°C until further use.

CHICKEN PATTY FORMULATION

Four chicken patty formulations were compared. Each contains either 0 (control), 2, 4 and 6% of dried cornsilk. The percentages of other ingredients are unchanged compared to the control sample, whereas the percentage of potato starch decreases with the increase of cornsilk fibre content. The dried cornsilk fibres were incorporated into the chicken patties using the formulations described in Table 1. The finished chicken patties were stored in a freezer at -18°C while waiting for further analysis. Chicken breast was purchased from the local wet market. Other dry materials were purchased from local suppliers.

PROCESSING

The chicken breast was manually cut using a cleaver and minced through a 4 mm-diameter grinder plate. The minced chicken flesh was stored at –18°C until processing time. Isolated soy protein was blended with water and shortening at a ratio of 1:5:5 using a Hobart mixer (N-50 Canada). The emulsion prepared (called pre-emulsion) was kept in a chiller (2-5°C) until ready for use. Salt was added to the frozen minced chicken and mixing was carried out using a Hobart mixer for 3 min. Water mixed with spices, potato starch, textured vegetable protein and cornsilk powder were added and mixed for another 2 min. The pre-emulsion was then added and mixing continued for another 2 min. The finished chicken batters were then weighed into 70 g portions, and then manually stamped to produce a uniform patty. The raw chicken patties were then frozen at –18°C until further analyses.

COOKING PROCEDURE

Chicken patties were thawed at 4°C for 12 h. The chicken patties were then cooked on a pan-fried electric skillet (Model KX-11K1, Sharp Corporation, Japan) for 7-8 min until an internal temperature of 72 ± 1°C was achieved.

PROXIMATE ANALYSES

Proximate analyses were conducted using AOAC (1996) for moisture, ash, protein by nitrogen conversion factor of 6.25 Kjeldahl method, (AOAC 1996) and crude fat content using the semi-continuous extraction [Soxhlet] method (AOAC 1996). All measurements were carried out in triplicate (n = 3).

COOKING YIELD

Cooking yield of the chicken patties were determined by measuring the weight of six patties for each treatment/ batch and calculations of weight differences for patties before and after cooking, were as follows (El-Magoli et al. 1996) :

$$\text{Cooking yield (\%)} = \frac{(\text{cooked weight} \times 100)}{\text{Raw weight}}.$$

MOISTURE AND FAT RETENTION (PERCENT)

The moisture and fat retention values represent the amount of moisture and fat retained in the cooked product per 100 g of raw sample, These values were calculated according to the following equations (El-Magoli et al. 1996):

$$\text{Moisture retention} = \frac{(\text{percent yield} \times \text{\% moisture in cooked patties})}{100}.$$

Fat retention (%)

$$= \frac{(\text{cooked weight} \times \text{percent fat in cooked chicken patties}) \times 100}{(\text{raw weight} \times \text{percent fat in raw chicken patties})}.$$

The change in chicken patties' diameter was determined using the following equation:

Diameter reduction (%)

$$= \frac{\text{raw chicken patties diameter} - \text{cooked chicken patties diameter} \times 100}{\text{raw chicken patties diameter}}.$$

SENSORY EVALUATION

Sensory evaluations were carried out by 60 untrained consumers consisting of students and staff of the School of Health Sciences, Universiti Sains Malaysia Health Campus. They evaluated samples for colour, texture, juiciness, chicken flavour, cornsilk flavour and overall acceptance on a 7 point scale (0 = dislike extremely and 7 = like extremely). Significance was established at $P \leq 0.05$ using statistics outline below.

STATISTICAL ANALYSIS

The data obtained were tested for significance using ANOVA and Duncan Multiple Range Test with SAS version 6.12 (SAS 1989). All measurements were carried out in triplicate (n = 3). The experiments were replicated twice.

RESULTS AND DISCUSSIONS

NUTRIENT COMPOSITION OF RAW CHICKEN PATTY WITH CORNSILK

The nutrient analyses of dried cornsilk and raw chicken patties formulated with ground cornsilk are shown in Table 2 and Table 3, respectively. Moisture content of raw chicken patties ranged from 53.13% to 58.22%. Control patties contained higher moisture content than patties formulated with cornsilk powder. They had 58.22% moisture while chicken patties containing 6% cornsilk powder had the lowest moisture content (53.13%).

Protein concentration was increased proportionally with the level of cornsilk powder used in raw chicken patty formulation. Chicken patty formulated with 6% cornsilk significantly (P<0.05) recorded the highest protein concentration (18.07%) followed by patty with 4% cornsilk (17.04%). On the other hand, the concentration of fat was inversely proportional to the cornsilk level in raw chicken patty. Chicken patty incorporated with 6% cornsilk was significantly (P<0.05) recorded the lowest concentration of fat at 14.85%. However, the fat content of raw chicken patty incorporated with 2% cornsilk (16.13%) were not significant (P>0.05) with control (16.55%). The highest protein and the lowest fat percentage detected in chicken patty formulated with 6% cornsilk powder may due to the moderate amount of protein (13.00%) existing originally in cornsilk used in this study (Wan Rosli et al. 2008).

Ash content was also increased with the level of consilk fibre in chicken patties. The percentage of ash in all raw chicken patties ranged from 1.71-2.21%. Chicken patties formulated with 6% cornsilk fibre recorded the highest concentration of ash at 2.21%.

NUTRIENT COMPOSITION OF COOKED CHICKEN PATTY WITH CORNSILK

The nutrient analyses of cooked chicken patties formulated with ground cornsilk are shown in Table 4. Moisture content of cooked chicken patties ranged from 42.73% to 46.40%. Control cooked chicken patties contained higher moisture content than patties formulated with cornsilk powder. They recorded 46.40% moisture while chicken patties containing 6% cornsilk powder recorded the lowest moisture content (42.73%). Reductions in moisture content of control chicken patties during cooking were as high as 20.3% (reduce from 58.22% (Table 3) to 46.40% (Table 4)) compared to chicken patty added with 6% cornsilk powder which was 19.5% (from 53.13% (Table 3) to 42.73% (Table 4)).

TABLE 1. Chicken patty formulated with different level of cornsilk powder

	Cornsilk powder level (%)			
Ingredients (%)	Control (0)	2	4	6
Chicken breast	54.0	54.0	54.0	54.0
Fat	9.0	9.0	9.0	9.0
Water	26.0	26.0	26.0	26.0
Potato starch	6.0	4.0	2.0	0.0
Dried cornsilk (%)	0.0	2.0	4.0	6.0
Isolated soy protein	3.0	3.0	3.0	3.0
Salt	1.0	1.0	1.0	1.0
Spices and seasoning	1.0	1.0	1.0	1.0
Total	100	100	100	100

TABLE 2. Chemical compositions of dried cornsilk

Chemical Compositions	Concentration (%)
Protein	13.0 ± 0.3
Fat	1.3 ± 0.2
Ash	5.3 ± 0.1
Total Dietary Fibre	38.4 ± 0.4

TABLE 3. Proximate analyses of raw chicken patty incorporated with cornsilk powder

Chemical	Cornsilk Level (%)			
Compositions (%)	0 (control)	2	4	6
Protein	13.84 ± 0.33^{b}	14.12 ± 0.40^{b}	17.04 ± 0.06^{a}	18.07 ± 1.16^{a}
Fat	16.55 ± 0.14^{a}	16.13 ± 0.20^{b}	15.15 ± 0.21^{c}	14.85 ± 0.05^{d}
Moisture	58.22 ± 0.09^{a}	57.04 ± 0.57^{b}	57.08 ± 0.27^{b}	53.13 ± 0.92^{c}
Ash	1.71 ± 0.03^{c}	1.73 ± 0.05^{c}	2.03 ± 0.05^{b}	2.21 ± 0.01^{a}

$^{a\text{-}d}$ Mean values within the same row bearing different superscripts differ significantly (P<0.05)

The addition of cornsilk powder to chicken burger formulations increased the protein content of the tested products. The concentration of protein increased proportionally with the level of cornsilk powder used in cooked chicken patty. Similar to raw chicken patties, cooked chicken patties formulated with 6% cornsilk significantly (P<0.05) showed the highest protein concentration (28.42%) followed by patty with 4% cornsilk (27.46%). The same trends of fat content in raw patties were recorded in cooked patties. Chicken patty formulated with 6% cornsilk show significantly (P<0.05) lower content of fat (14.60%). The percentage of ash in all cooked chicken patties range from 2.47 to 2.77% with patty contained 6% cornsilk recorded the highest percentage at 2.77%.

The physical characteristics of cooked chicken patties containing cornsilk powder are presented in Table 5. Compared to control sample, chicken patties formulated with cornsilk powder showed an increase (P<0.05) in cooking yield with the level of fibres ranging from 2% until 6% of cornsilk powder. Cornsilk-added chicken patties had higher cooking yield ranging from 77.23 – 83.03% compared to control patty which had 73.70%. The high cooking loss from the control patty could be attributed to the high loss of moisture and fat during cooking. Cooking yield was significantly (P>0.05) higher in chicken patty incorporated with cornsilk. Patty formulated with 6% cornsilk powder recorded the highest cooking yield (83.03%) compared to other treatments. This is probably due to the ability of cornsilk hydrocolloidal fibre to create a tridimensional matrix, holding not only water, but also fat added to the formulas, avoiding losses of fat and water during cooking (Warner & Inglett 1997).

In control patties, fat was more easily removed during cooking, probably due a low density meat protein matrix, along with a high fat unstability. This is in agreement with a previous study (Suman & Sharma 2003) where the effect of grind size and physico-chemical and sensory characteristics of low-fat ground buffalo meat patties had been presented.

The results of moisture retention of chicken patties formulated with cornsilk powder were similar with the trend of cooking yield. The moisture retention was proportionally increased with the increment of fibre content in patty formulations. The higher the amount of cornsilk powder, the lower the loss of moisture during cooking.

Control chicken patties showed more moisture and fat loss (P<0.05) after cooking as compared to cornsilk-added chicken patty. Control chicken patty recorded 58.73% moisture retention and 70.34% fat retention while cornsilk-added chicken patty recorded moisture and fat retention ranging from 59.15-66.78% and 74.15-81.64%, respectively. This effect may be due to the action of dietary fibre in the cornsilk based patties. Dietary fibres increased cooking yield because of their strong ability to keep moisture and fat in the matrix. This finding is supported by the previous work of (Aleson-Carbonell et al. 2005) on the incorporation of lemon albedo fibres in beef burger formulation. Similar findings were documented by Mansour and Khalil (1997) and Turhan et al. (2005), who have utilized wheat fibres and hazelnut pellicles, respectively in beef patty formulations.

The high moisture retention in cornsilk -added chicken patty may be also due to the non-meat protein presented in the cornsilk powder. Cornsilk powder recorded 13% protein (Table 2) (Wan Rosli et al. 2008). Some non-meat

TABLE 4. Proximate analyses of cooked chicken patty incorporated with cornsilk powder

	Cornsilk Level (%)			
Chemical Compositions (%)	0 (control)	2	4	6
Protein	21.62 ± 0.11^c	27.34 ± 0.32^b	27.46 ± 0.36^b	28.42 ± 0.04^a
Fat	15.80 ± 0.10^a	15.53 ± 0.18^{ab}	15.22 ± 0.21^b	14.60 ± 0.12^c
Moisture	46.40 ± 0.20^a	43.80 ± 0.39^b	43.04 ± 0.50^b	42.73 ± 0.54^b
Ash	2.47 ± 0.01^c	2.61 ± 0.06^b	2.63 ± 0.04^b	2.77 ± 0.05^a

$^{a\text{-}b}$ Mean values within the same row bearing different superscripts differ significantly (P<0.05)

TABLE 5. Cooking yield of cooked chicken patty incorporated with cornsilk powder

	Cornsilk Level (%)			
Physical Traits (%)	0	2	4	6
Moisture Retention	58.73 ± 0.92^a	59.15 ± 1.53^{ab}	59.95 ± 1.33^{ab}	66.78 ± 1.11^b
Fat Retention	70.34 ± 1.10^b	74.15 ± 1.92^{ab}	79.91 ± 1.78^{ab}	81.64 ± 1.35^a
Diameter Retention	11.61 ± 0.62^a	11.73 ± 0.69^a	11.59 ± 0.50^a	11.84 ± 0.27^a
Cooking Yield	73.70 ± 1.15^b	77.23 ± 2.29^{ab}	79.52 ± 1.77^{ab}	83.03 ± 1.38^a

$^{a\text{-}b}$ Mean values within the same row bearing different superscripts differ significantly (P<0.05) proteins can also be used as fat replacers owing to their ability to bind water and to form gels, thus, responding to consumers demands for healthier and low fat products (Pietrasik & Duda 2000). The use of cowpea or peanut flours as meat extenders will reduce production cost in chicken nuggets (Prinyawiwatkul et al. 1997).

Diameter retention also increased with increase level of cornsilk powder added in chicken patty formulations. Even though this cooking trait values were higher in patty containing cornsilk they were however not significantly different (P>0.05) with that of control. These findings were similar to the study done by Pinero et al. (2008) where it was reported that there were no significance in the diameter reduction of low-fat burger containing oat's soluble fibre and control. The retention of the size and shape of cornsilk-added chicken patty during cooking could be due to the binding and stabilizing property of cornsilk fibre, which held the meat particle together and resisted changes in the shape of the product.

The present study showed that the percent of cooking yield during cooking was comparatively higher than other study. For example, Sheard and co-researchers reported that cooking loss of grilled and fried beef patties containing 9-30% of fat ranged from 22 – 36% (Sheard et al. 1998) and Pinero et al. (2008) reported that the cooking loss of 25 and 29% respectively in beef patties incorporated with different amounts of oat fibres. In this study only 15% fat was used in patty formulation and the cooking loss was less than 20% compared to Sheard et al. (1998). From these results, it can be suggested that cooking loss increased proportionally with fat content in burger formulation. As the fat content increases, the mean free distance between fat cells decreases, raising the likelihood of fat coalescing and then leaking from the products. Thus, high fat products tend to lose large amounts of fat during cooking whilst low fat meat products lose relatively little fat (Tornberg et al. 1989).

Many manufacturers have introduced several modifications in attempts at offsetting the detrimental effects of reducing fat level. In this regard, carbohydrates and fibre have been used successful in improving cooking yield, reducing formulation cost and enhancing texture (Jimenez & Colmenero 1996).

SENSORY ATTRIBUTES

Table 6 shows the sensory evaluation scores for chicken patties incorporated with cornsilk. Generally, the scores of all attributes were decreased with the level of cornsilk powder in patty formulations. However, all chicken patties incorporated with 2%, 4% and 6% cornsilk powder were not significantly different (P>0.05) compared to control chicken patty for all attributes. Among all cornsilk-based patty treatments, patties containing 2% cornsilk powder had the highest scores for all sensory attributes. Even though chicken patties formulated with 4% and 6% cornsilk had lower scores of all sensory attributes but are not significantly different with that of control. Panelists gave the least score for overall acceptance of the patty prepared with 6% cornsilk powder. This data indicated that consumers preferred 2% cornsilk added to the patty formulation. Consumers were unable to differentiate aroma, colour, texture, juiciness and chicken flavour of chicken patties made from different levels of cornsilk. These findings are in line to our previous study where the usage of cornsilk dietary fibre did not change the sensory properties and consumer acceptability of cornsilk-based beef patties (Wan Rosli et al. 2011). The present study also showed that the overall acceptance of cornsilk based patties was similar to the control patty.

CONCLUSION

Incorporation of cornsilk powder resulted in increased protein, cooking yield, moisture and fat retention but decreased fat content of chicken patties. Chicken patties with 6% cornsilk-added showed the highest cooking yield, moisture and fat retention but less acceptable by consumers. This could be attributed to the high retention of moisture and fat during cooking. Consumers were not able to differentiate all sensory attributes between chicken patties containing different level of dried cornsilk and control. In summary, the addition of cornsilk resulted in

TABLE 6. Sensory attributes of cooked chicken patties as influenced by the addition of cornsilk (N=60)

	Cornsilk Level (%)			
Sensory Attributes	0	2	4	6
Aroma	5.28±0.94[a]	5.19±1.11[a]	4.93±1.07[a]	4.82±1.14[a]
Colour	5.46±1.05[a]	5.07±1.03[a]	4.98±1.19[a]	4.80±1.11[a]
Texture	4.88±1.09[a]	4.88±1.22[a]	4.68±1.19[a]	4.42±1.18[a]
Juiciness	4.67±1.19[a]	4.58±1.22[a]	4.63±1.06[a]	4.33±1.15[a]
Chicken flavour	5.28±1.00[a]	5.00±1.21[a]	4.93±1.17[a]	3.86±1.26[a]
Cornsilk flavour	4.82±1.27[a]	4.68±1.24[a]	4.57±1.20[a]	4.02±1.28[a]
Overall acceptance	5.33±1.09[a]	5.09±1.00[a]	4.82±1.22[a]	4.25±1.22[a]

[a-b] Mean values within the same row bearing different superscripts differ significantly (P<0.05)

an increase in the nutritional compositions, water and fat holding capacity of chicken patties while maintaining the sensory quality so as to be more acceptable to consumers. This novel item for incorporation in chicken patties could permit a reduction of the formulation cost without affecting sensory descriptors of the product to which the consumer is familiarized.

ACKNOWLEDGEMENTS

The authors appreciate the funding from Universiti Sains Malaysia short term grant 304/PPSK/6131549, 304/PPSK/6131020, Rosliza, Mohd Zaki Selamat, Saiful Haizad, Nik Fakurudin, Norazita, Rina Rizak, Roziyani and other staffs of School of Health Sciences who participated in sensory evaluation of cornsilk based products. The authors would also like to thank Mohd Sabri for his technical assistance in the research.

REFERENCES

Ako, C. 1998. Fat replacers. *Food Technology* 52: 47-53.

Aleson-Carbonell, L., Fernandez-Lopez, J., Perez-Alvarez, J.A. & Kuri, V. 2005. Characteristics of beef burger as influenced by various type of lemon albedo. *Innov. Food Sci. Emer. Technol* 6: 247-255.

AOAC. 1996. Official Methods of Analysis of AOAC International. 16th edition. *AOAC* International Suite 500, Maryland USA.

Babji, A.S., Alina, A.R., Mohd Suria Affandi, Y. & Wan Sulaiman, W.I. 2001. Palm oil: A healthy fat substitute?. *Meat International* 11(2): 26-27.

Besbes, S., Attia, H., Deroanne, C., Makni, S. & Blecker, C. 2008. Partial replacement of meat by pea fiber and wheat fiber: effect on the chemical composition, cooking characteristics and sensory properties of beef burgers. *Journal of Food Quality* 31: 480-489.

Chizzolini, R., Zanardi, E., Dorigoni, V. & Ghidini, S. 1999. Calorific value and cholesterol content of normal and low-fat meat and meat products. *Trends in Food Science & Technology* 10: 119-128.

Clement, M. 2010. 2010 positive for global poultry production. *Poultry International* Jan: 8-9.

Colmenero, F. J. 1996. Technologies for developing low-fat meat products. *Trends in Food Science & Technology* 7: 41-48.

Desmond, E., Troy, D. & Buckley, D. 1998. Comparative studies of nonmeat adjuncts used in the manufacture of low-fat beef burgers. *Journal of Muscle Foods* 9(3): 221-241.

Dongowski, G., Drzikova, B., Senge, B., Blochwitz, R., Gebhardt, E. & Habel, A. 2003. Rheological behaviour of β-glucan preparations from oat products. *Food Chemistry* 93: 279-291.

El-Ghorab, A., El-Massry, K.F. & Shibamoto, K. 2007. Chemical composition of the volatile extract and antioxidant activities of the volatile and nonvolatile extracts of Egyptian corn silk (*Zea mays* L.). *Journal Agriculture Food Chemistry* 55 (22): 9124-9127.

El-Magoli, S., Laroia, S. & Hansen, P. 1996. Flavor and texture characteristics of low fat ground beef patties formulated with whey protein concentrate. *Meat Science* 42(2): 179-193.

García, M., Dominguez, R., Galvez, M., Casas, C. & Selgas, M. 2002. Utilization of cereal and fruit fibres in low fat dry fermented sausages. *Meat Science* 60(3): 227-236.

Guevara, P., Perez-Amador, M.C., Zuniga, B. & Snook, M. 2000. Flavones in corn silks and resistance to insect attacks. *Phyton* 69: 151-156.

Hecker, K., Marg, M., Newman, R. & Newman, W. 1998. Barley β-glucan is effective as a hypocholesterolaemic ingredient in foods. *Journal of the Science of Food and Agriculture* 77: 179-183.

Inglett, G., Peterson, S., Carriere, C. & Maneepun, S. 2005. Rheological, textural and sensory properties of Asian noodles containing on oat cereal hydrocolloid. *Food Chemistry* 90(1&2): 1-8.

Jimenez C.F. 1996. Technologies for developing low-fat meat products. *Trends in Food Science and Technology* 7: 41-48.

Keeton, J.T. 1994. Low-fat meats products technological problems with processing. *Meat Science* 36: 261-276.

Koedam, A. 1986. Volatile oil composition of Greek mountain tea (*Sideritis spp*.). *Journal of the Science of Food and Agriculture* 36: 681-684.

Kwag, J.J., Lee, J.G., Jang, H.J. & Kim, O.C. 1999. Volatile components of corn silk (*Zea mays* L.). *Han'guk Sikp'um Yongyang Hakhoechi* 12(4): 375-379.

Mansour, E. & Khalil, A. 1999. Characteristics of low-fat beef burgers as influenced by various types of wheat fibres. *Journal of the Science of Food and Agriculture* 79: 493-498.

Mansour, E.H. & Khalil, A.H. 1997. Characteristics of low fat beef burgers as influenced by various types of wheat fibers. *Food Research International* 30: 199-205

McWatters, K.H. 1990. Functional characteristics of cowpea flours on foods. *JAOCS* 67: 272-275.

Menkhaus, D.J. & Colin, D.P.M. 1993. Field, The effects of perceived product attributes on the perception of beef. *Agribusiness* 9: 57-63.

Ollberding, N.J. 2008. Changes in food sources of fat, cholesterol, and protein in the diets of adolescents with hypertension in response to a dietary intervention focusing on fruits, vegetables, and low-fat dairy foods. MSc Thesis. Universiti of Cincinnati USA. (unpublished)

Pietrasik, Z. & Duda, Z. 2000. Effect of fat content and soy protein/carrageenan mix on the quality characteristics of comminuted, scalded sausages. *Meat Science* 56: 181-188.

Pinero, M.P., Parra, K., Huerta-Leidenz, N., Moreno, A.A., Ferrer, M., Araujo, S. & Barboza, Y. 2008. Effect of oat's soluble fibre (β-glucan) as a fat replacer on physical, chemical, microbiological and sensory properties of low-fat beef patties. *Meat Science* 80: 675-680.

Prinyawiwatkul, W., McWatters, K.H., Beuchat, L.R. & Phillips, R. D. 1997. Physicochemical and sensory properties of chicken nuggets extended with fermented cowpea and peanut flours. *J. Agric. Food Chem* 45: 1891-1899.

Resurreccion, A.V. A. 2004. Sensory aspects of consumer choices for meat and meat products. *Meat Science* 66: 11-20.

Sang-Kyu, C. & Hye-Seon, C. 2004. Purification and characterization of an anticoagulant from corn silk. *Han'guk Sikp'um Yongyang Kwahak Hoechi* 33(8): 1262-1267.

SAS. 1989. SAS User's Guide: Statistics. Version 6.12, SAS Institute Inc., Cary, NC.

Sayago-Ayerdi, S.G., Brenes, A., Viveros, A. & Goni, I. 2009. Antioxidative effect of dietary grape pomace concentrate on lipid oxidation of chilled and long-term frozen stored chicken patties. *Meat Science* 83: 528-533.

Sheard, P.R., Nute, G.R. & Chappell, A.G. 1998. The effect of cooking on the chemical composition of meat products with special reference to fat loss. *Meat Science* 49(2): 175-191.

Shiota, K., Kawahara, S., Tajima, A., Ogata, T.K. & Ito, T. 1995. Sensory evaluation of beef patties and sausages containing lipids with various component fatty acids. *Meat Science* 40: 363-371.

Suman, S. & Sharma, B. 2003. Effect of grind size and levels on the physico-chemical and sensory characteristics of low-fat ground buffalo meat patties. *Meat Science* 65: 973-976.

Tanga, S., Kerry, J. P., Sheehan, D., Buckley, D.J. & Morrissey, P. A. 2001. Antioxidative effect of added tea catechins on susceptibility of cooked red meat, poultry and fish patties to lipid oxidation. *Food Research International* 34: 651-657.

Tornberg, E., Olsson, A. & Persson, K. 1989. A comparison in fat holding between hamburgers and emulsion sausages. *Proceedings of the 35th International Congress of Meat Science and Technology, Copenhagen, Denmark* 752-759.

Turhan, S., Sagir, I. & Ustin, N.S. 2005. Utilization of hazelnut pellicle in low-fat beef burgers. *Meat Science* 71: 312-316.

USDA. 2002. USDA/Economic Research Service. Changing consumer demands create opportunities for U.S. food system. *Food Review* 25: 19-22.

Wan Rosli, W.I., Nurhanan, A.R., Solihah, M.A. & Mohsin, S.S.J. 2011. Cornsilk (*zea mays* hairs) improves nutrient content and cooking characteristics of beef patties. *Sains Malaysiana* 40(2): 15-161.

Wan Rosli, W.I., Babji, A.S., Aminah, A., Foo, S.P. & Abd Malik, O. 2010. Effect of retorting and oven cooking on the nutritional properties of beef frankfurters blended with palm oils. *Int. J. Food Sci, & Nutr, CIJF 459667*. 61(5): 519-535.

Wan Rosli, W.I., Jesmine, K., Nurhanan, A.R., Mohsin, S.S.J. & Farid, C.G. 2008. Aqueous, alcoholic treated and proximate analysis of *Maydis stigma* (*Zea mays* hairs). *Annals of Microscopy* 8: 66-72.

Warner, K. & Inglett, G. 1997. Flavor and texture characteristics of foods containing Z-trim corn and oat fibers as fat and flour replace. *Cereal Food World* 42(10): 821-825.

Yesilada, E. & Ezer, N. 1989. The antiinflammatory activity of some sideritis species growing in Turkey. *International Journal of Crude Drug Research* 27: 38-40.

Yilmaz, I. & Daglioglu, O. 2003. The effect of replacing fat with oat bran on fatty acid composition and physicochemical properties of meatballs. *Meat Science* 65(2): 819-823.

Nutrition Program, School of Health Sciences
Universiti Sains Malaysia
Health Campus
16150 Kubang Kerian
Kelantan, Malaysia

*Corresponding author; email: rosliishak@gmail.com

Received: 13 October 2010
Accepted: 25 November 2010