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Maydis stigma Improves Physical Traits and Unchanged Sensory Properties of Beef and Chicken Patties

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***Abstract*—**The proximate composition, physical traits and sensory properties of beef and chicken patties incorporated with various level of dried cornsilk (*Maydis stigma*) were studied. The beef and chicken patties were formulated with either 2%, 4% or 6% of cornsilk. Both cooked beef and chicken patties incorporated with 6% cornsilk recorded the highest protein concentration at 23.3% and 28.42%, respectively. Both cooked beef and chicken patties containing 6% cornsilk significantly recorded the lowest concentration of fat at 11.4% and 14.60%, respectively. Beef and chicken patties formulated with 6% cornsilk recorded the highest cooking yield at 80.13% and 83.03% compared to other treatments. The inclusion of cornsilk did not change the sensory properties and consumer acceptability of cornsilk-based beef and chicken patties. Cornsilk fibre has been effective in improving cooking yield, moisture and fat retention of beef and chicken patties

***Keywords*—**cornsilk, beef and chicken patty, proximate composition, sensory evaluation.

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I. Introduction

BEEF and chicken are two major important sources of protein. With the growth in world economy, the beef consumption has seen a significant increase in past and hence it is now the third most favored source of protein in meat consumption. World beef production and consumption is growing steadily and is estimated to grow further [1]. Worldwide consumption of chicken meat is also increase tremendously and parallel with its production. The chicken meat production is forecast to increase 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 [2].

Beef and 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 their affordable cost, availability in different tastes and longer shelf life. Extensive studies have been conducted to the use of various types of fat replacer and plant dietary fibre in processed meat products in improving dietary fibre and lowering fat content. The utilization of tapioca starch, oat fibre [3]-[6], cereal and fruit fibres [7]-[8], whey protein [5], palm based fat [9] on the physical, chemical and sensory properties of low-fat beef patties has been studied previously.

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Presently, consumers are very concern about their diet and the food they have eaten. When peoples demand nutritious and healthy food products, processed meat producers have to focus their creation toward processed meats that are lean, low fat and high in protein content. Health concerns about fat utilization and changes in consumer's preferences have led to comprehensive research on low-fat foods [10]-[11]. The high contents of saturated fats and cholesterol have been a major problem, resulting in meat products becoming the subject of scrutiny by nutritional, medical, and consumer groups. The American Heart Association [12] and other health groups have recommended a decrease in the consumption of animal fats. Decreases in calories from fat, from 40% to 30% and in saturated fat intake from 18% to 10%, have also been recommended [13].

Reduction of fat in processed ground meat products presents a number of difficulties in terms of appearance, flavor and texture. Manufacturers have introduced several modifications in an attempt to offset the detrimental effects of reducing the fat level. These modifications include the use of non-meat ingredients that could help to convey desirable texture and, more important, enhance water-holding capacity [14]. In this regard, carbohydrates and dietary fibre have been successful in improving cooking yield, reducing formulation cost and enhancing texture [15].

Cornsilk (*Maydis stigma*) fibre refers 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. Traditionally, infusion of cornsilks had been used as a therapeutic remedy. These 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 [17]. Cornsilk contain various chemicals, including proteins, vitamins, alkaloids, tannins and mineral salts, carbohydrates, steroids, and flavonoids as well as other volatile chemicals [18].

The pharmaceutical and biological activities of cornsilk constituents are well reported in the literatures. These include antibiotic activity of glycoside maysin [19], attractant activity toward corn earworm [20], purification and characterization of anticoagulant [21]. 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 [22]. However, the utilization of consilk in any meat product is never been studied.

Thus, this study investigated the physical traits and sensory properties of beef and patties formulated with added cornsilk fibre.

II. Materials And Methods

A. Preparation of Cornsilk

Fresh young cornsilks (*Maydis stigma*) 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

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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 before further analyses.

B. Beef and Chicken patty Formulation

The beef and chicken patties were prepared followed the formulations described by the lead author's formulations [23] with slight modification. Four beef and chicken patty formulations were compared. Each of them 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 beef and chicken patties using the formulations described in Table 1. The finished beef and chicken patties were stored in a freezer at -18^{o}C while waiting for further analysis. Beef cut of hind quarter and chicken breasts were purchased from local wet market. Other dry materials were purchased from local suppliers.

TABLE I
BEEF AND CHICKEN PATTIES FORMULATED WITH DIFFERENT LEVEL OF CORNSILK POWDER

	Cornsilk powder level (%)			
Ingredients (%)	**Control (0)**	**2**	**4**	**6**
Beef (hind quarter) or 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, Spices and seasoning	2.0	2.0	2.0	2.0
Total	100	100	100	100

C. Processing

The frozen beef and chicken meats were manually cut using a band saw (JG-210) and minced through a 4 mm-diameter grinder plate. The minced beef was stored at –18^{o}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^{o}C) until ready for use. Salt was added to the frozen minced beef and mixing was carried out using a Hobart mixer for 3 minutes. Water mixed with spices, potato starch 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 meat batters were then weighed into 70g portions, and then manually stamped to produce a uniform beef patty. The raw beef patties were then frozen in a freezer at –18^{o}C.

D. Cooking Procedure

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

Cooking Yield

Cooking yield of patties was determined by measuring the weight of six patties for each treatment/batch and calculating weight differences for patties before and after cooking, as follows [5]:

Cooking yield (%) = (cooked weight/Raw weight) x 100

Moisture and Fat Retention (%)

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 [5].

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

$$\text{Fat retention (\%)} = \frac{\text{(cooked weight x percent fat in cooked patties)}}{\text{(raw weight x percent fat in raw patties)}} \times 100$$

Diameter Reduction (%)

Change in patties' diameter was determined using the following equation:

$$\text{Diameter reduction (\%)} = \frac{\text{raw patties diameter} - \text{cooked patties diameter}}{\text{raw patties diameter}} \times 100$$

Sensory Evaluations

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, beef flavour, chicken flavour, cornsilk flavour and overall acceptance on a 7 point scale (0 = dislike extremely and 7 = like extremely). Significance was established at $P \leq 0.05$ unless otherwise indicated.

E. Statistical Analysis

Data obtained were tested for significance using ANOVA and Duncan Multiple Range Test with SAS version 6.12 [24]. All measurements were carried out in triplicate.

III. RESULTS AND DISCUSSION

The nutrient analyses of cooked beef patties formulated with ground cornsilk are shown in Table 2. Generally, protein concentration was increased proportionally with the level of cornsilk powder used in cooked beef patty formulation. Cooked beef patties formulated with 6% cornsilk significantly ($P<0.05$) recorded the highest protein concentration (23.26%) followed by patty with 4% cornsilk (21.30%). On the other hand, the concentration of fat was inversely proportional to the cornsilk level in cooked beef patty. Beef patty formulated with 6% cornsilk significantly ($P<0.05$) recorded the lowest content of fat (11.39%). However, the fat content of raw beef patty incorporated with 2 and 4% cornsilk were not significant ($P<0.05$) with control. The highest protein and the lowest fat percentage detected in beef patty formulated with 6% cornsilk powder may due to the moderate amount of protein (13.00%) existing originally in dried cornsilk used in this study [25].

The percentage of ash in all cooked beef patties were ranging from 2.75 -3.45 % with patty contained 6% cornsilk recorded the higher percentage of ash. There was also no difference in moisture content between all raw patties. All cooked patty samples recorded moisture content ranging from 40.42-42.98%. These values were comparable with our previous result [26].

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TABLE II
NUTRIENT ANALYSES OF COOKED BEEF PATTY INCORPORATED WITH CORNSILK POWDER

Cornsilk level (%)	Concentration (Percent)			
	Protein	Fat	Ash	Moisture
Control (0)	19.53 + 0.41^{c}	13.18 ± 1.11^{a}	2.75 ± 0.03^{b}	42.98 ± 1.21^{a}
2	20.00 + 0.48^{c}	12.81 ± 0.91^{a}	2.83 ± 0.11^{c}	42.97 ± 1.78^{a}
4	21.29 + 0.13^{b}	11.88 ± 0.28^{ab}	2.89 ± 0.13^{c}	42.70 ± 1.59^{a}
6	23.26 + 0.26^{a}	11.39 ± 0.39^{b}	3.45 ± 0.42^{a}	40.42 ± 1.01^{a}

$^{a-c}$ Mean values within the same column bearing different superscripts differ significantly (P<0.05)

The addition of cornsilk powder to chicken burger formulations also increased the protein content of the tested products (Table 3). The concentration of protein was increased proportionally with the level of cornsilk powder used in cooked chicken patty. Similar to cooked beef patties, cooked chicken patties formulated with 6% cornsilk significantly (P<0.05) show the highest protein concentration (28.42%) followed by patty with 4% cornsilk (27.46%). The same trends of fat content in cooked beef patties were recorded in cooked chicken 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%.

TABLE III
NUTRIENT ANALYSES OF COOKED CHICKEN PATTY INCORPORATED WITH CORNSILK POWDER

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

$^{a-c}$ Mean values within the same column bearing different superscripts differ significantly (P<0.05)

Physical traits of cooked beef patties are presented in Table 4. Compared to control sample, beef patties formulated with cornsilk powder showed an increase (P < 0.05) in cooking yield. In fact, the high cooking loss was from the control patty. This could be attributed to the high loss of moisture and fat during cooking. Cooking yield was significantly (P > 0.05) higher in beef patty incorporated with cornsilk. Patty formulated with 6% cornsilk powder recorded the highest cooking yield (80.13%) compared to other treatments. The results of moisture retention of beef 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.

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 (Table 5). Cornsilk based chicken patty had higher cooking yield ranging from 77.23 – 83.03% compared to control patty which had 73.70%. Cooking yield was significantly (P > 0.05) higher in beef and chicken patty incorporated with cornsilk. Patty formulated with 6% cornsilk powder recorded the highest cooking yield (80.13%) compared to other treatments. This 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 [27]. 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 an agreement with previous research [28] who studied the effect of grind size and levels on the physico-chemical and sensory characteristics of low-fat ground buffalo meat patties.

TABLE VI
PHYSICAL TRAITS OF COOKED BEEF PATTY INCORPORATED WITH CORNSILK POWDER

Cornsilk level (%)	Percent			
	Moisture retention	Fat Retention	Diameter Retention	Cooking Yield
Control (0)	58.76±1.44^{c}	70.69±1.76^{b}	7.63±0.16^{a}	76.37±1.86^{c}
2	60.17±1.35^{bc}	72.61±1.23^{ab}	7.77±0.16^{a}	77.95± 1.40^{bc}
4	62.17±1.11^{ab}	72.42±0.30^{ab}	7.76±0.23^{a}	79.51±0.53 ^{ab}
6	62.49±0.84^{a}	73.68±1.06^{a}	7.77±0.21^{a}	80.13±1.15^{a}

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

The results of moisture retention of beef and chicken burgers 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 burger formulations. The higher the amount of cornsilk powder, the lower the loss of moisture during cooking. Control beef patty shows more moisture and fat loss (P < 0.05) after cooking as compared to cornsilk-added beef patty. Control beef patty recorded 58.76% moisture retention and 70.69% fat retention while cornsilk-added beef patty recorded moisture and fat retention ranging from 60.17-62.49% and 72.61-73.68%, respectively (Table 4).

Control chicken patties show 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 (Table 5). This trend may be due to the action of dietary fibre content in the cornsilk based patties. Dietary fibres increased cooking yield because of their high ability to keep moisture and fat in the matrix. This finding is supported by the previous work of [29] on the incorporation of lemon albedo fibres in beef burger formulation. Similar findings were documented by [30] and [31], who have utilized wheat fibres and hazelnut pellicles, respectively in beef patty formulations.

TABLE V
PHYSICAL TRAITS OF COOKED CHICKEN PATTY INCORPORATED WITH CORNSILK POWDER

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

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

The high moisture retention in chicken-added cornsilk patty may be also due to the non-meat protein presented in the cornsilk powder used in this study. Cornsilk powder recorded 13% protein [32]. Some non-meat 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 [33]. The use of cowpea or peanut flours as meat extenders will reduce production cost in chicken nuggets [34].

Diameter retention was also increased with the level of cornsilk powder in beef and chicken patty formulations. Even though this cooking trait values were higher in beef and chicken patties

containing cornsilk but they were not significantly different (P > 0.05) with control. These findings were similar to the study done by [35] who reported that there were no significant in diameter reduction of low-fat patty containing oat's soluble fibre and control. The retention of the size and shape of cornsilk-added beef 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.

In this present study, the percent of cooking yield during cooking was comparatively higher than other study. For example, reference [36] reported that cooking loss of grilled and fried beef patties contained 9-30% of fat were ranging from 22 – 36%. This present study only used 15% fat in burger formulation and the cooking loss was less than 20% as compared to [36]. From this result, 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 [37]. Manufacturers have introduced several modifications in an attempt to offset the detrimental effects of reducing the fat level. In this regard, carbohydrates and fibre have been successful in improving cooking yield, reducing formulation cost and enhancing texture [38].

Table 6 and 7 show the sensory evaluation scores for beef and chicken patties incorporated with cornsilk. All cooked beef and chicken patties incorporated with 4 and 6% cornsilk powder were not significantly different (P>0.05) compared to control beef patty for all attributes. Beef patty containing cornsilk were found to be significantly (P < 0.05) flavourful than the control which could be due attributed to the increased amount of cornsilk used in the formulation.

TABLE VI
SENSORY ATTRIBUTES OF COOKED BEEF PATTIES AS INFLUENCED BY THE ADDITION OF CORNSILK (N= 60)

Sensory attribute	Cornsilk Level (%)			
	0	2	4	6
Colour	4.98±0.94[a]	4.86±1.03[a]	4.58±1.16[a]	4.36±1.19[a]
Texture	5.04±1.09[a]	4.72±1.14[a]	4.62±1.08[a]	4.74±1.10[a]
Juiciness	4.92±1.10[a]	4.76±1.03[a]	4.50±1.06[a]	4.62±1.07[a]
Beef flavour	5.02±1.07[a]	4.72±1.16[a]	4.86±1.04[a]	4.78±1.06[a]
Cornsilk flavour	4.04±1.04[a]	3.86±1.04[a]	4.36±1.05[a]	4.48±1.04[a]
Overall acceptance	5.10±1.07[a]	4.94±1.00[a]	4.96±1.10[a]	4.96±1.09[a]

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

Consumers were unable to differentiate colour and juiciness of beef and chicken patties made from different levels of cornsilk. These findings not agree with those of [35] who found that beef patties containing oat's fibre were found to be significantly (P>0.05) juicier than the control, which could be attributed to the increased moisture retention of the product during cooking. The score for beef and chicken patties containing 4 and 6% of cornsilk were comparable to control (P>0.05) for all sensory attributes. All sensory attributes from these treatments were not significant different (P>0.05) with control. The overall acceptance of cornsilk based patties was similar to the control patty. This is similar to the report by [39] who found that there was no negative effect of wheat fibre concentrate addition, up to 1.5%, on flavour and texture of beef burgers.

TABLE VII
SENSORY ATTRIBUTES OF COOKED CHICKEN PATTIES AS INFLUENCED BY THE ADDITION OF CORNSILK (N= 60)

Sensory attributes	Cornsilk Level (%)			
	0	2	4	6
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)

IV. CONCLUSIONS

Inclusion of cornsilk powder resulted in increasing protein, cooking yield, moisture and fat retention but decreasing fat content. Beef and chicken patties with 6% corn silk-added showed the highest cooking yield, moisture and fat retention. This could be attributed to the high retention of moisture and fat during cooking. Consumers were not able to differentiate colour, juiciness and overall attributes between patties containing different level of dried cornsilk and control. In summary, addition of cornsilk resulted in an increase in the nutritional composition, water and fat holding capacity while maintaining the sensory quality of beef and chicken patties so they are as acceptable to consumers as normal patties. This incorporation could permit a reduction of the formulation cost without affecting sensory descriptors of the product to which the consumer is familiarized.

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