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Quality Assessment of Local and Franchise Beef and Chicken Burgers

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ABSTRAK

Enam jenama burger lembu dan ayam, tiga jenama burger lembu francais dan dua jenama burger ayam francais telah dinilai dari segi kandungan proksimat, kandungan daging dan mioglobin, warna (nilai L, a, b) dan kandungan mikrobiologi iaitu Kiraan Jumlah Plat (CFU/gm), Kiraan Koliform dan Escherichia coli *(MPN/gm), Kiraan* Staphylococus aureus *(CFU/gm) dan kehadiran* Salmonella *sp. Kesemua burger lembu francais mempunyai kandungan protein dan kelembapan yang lebih tinggi (kecuali burger C) dan kandungan karbohidrat yang lebih rendah dari jenama tempatan. Didapati tiada perbezaan yang nyata ($p > 0.05$) dalam kandungan abu, lemak dan serabut kasar antara burger lembu francais dan jenama tempatan. Kebanyakan burger ayam jenama tempatan mempunyai kandungan protein dan kelembapan yang lebih rendah dan kandungan lemak, serabut dan karbohidrat yang lebih tinggi berbanding dengan burger ayam francais. Didapati tiada perbezaan yang nyata ($p > 0.05$) dalam kandungan abu antara burger ayam jenama tempatan dan francais. Kesemua burger lembu mempunyai kandungan mioglobin dan daging yang rendah (< 65%) kecuali burger A1, F1 dan G1. Burger ayam E1, F1dan burger francais B mempunyai kandungan daging yang lebih tinggi (> 65%) berbanding dengan yang lain. Kesemua burger ayam dan lembu mempunyai nilai 'L' yang lebih tinggi iaitu antara 45.13% hingga 53.68% dan 62.75% hingga 72.48% masing-masing kecuali F1 yang lebih gelap. Burger lembu jenama tempatan mempunyai nilai 'a' lebih tinggi berbanding dengan francais dan kesemua burger ayam mempunyai nilai 'a' yang rendah kecuali F1 yang lebih merah. Kiraan Jumlah Plat, Kiraan Koliform dan* E. coli *yang rendah didapati di dalam semua sampel burger. Kiraan* S. aureus *dalam sampel burger lembu dan ayam berjenama tempatan adalah lebih tinggi daripada francais iaitu antara 2 hingga 11 CFU/gm sampel dan antara 6 hingga 22 CFU/gm sampel masing-masing. Tiada kehadiran* Salmonella *sp dapat dikesan dalam semua sampel burger.*

ABSTRACT

Six brands of local beef and chicken burgers, three brands of franchise beef and two brands of franchise chicken burgers were evaluated for proximate composition, myoglobin and meat content, colour (L, a, b values) and microbiology composition i.e. Total Plate Count (CFU/gm), Coliform and Escherichia coli *Counts (MPN/gm),* Staphylococus aureus *Count (CFU/gm) and presence of* Salmonella *sp. All franchise beef burgers had higher protein and moisture contents (except burger C) and lower carbohydrate content than the local brands. No significant differences ($p > 0.05$) in fat, ash and crude fibre contents were observed between local brands and franchise beef burgers. Most local brands of chicken burgers had lower levels of protein and moisture and higher levels of fat, fibre and carbohydrate than the franchises. No significant differences ($p > 0.05$) in ash content was observed between the local brands and franchise chicken burgers. All beef burgers had low myoglobin and meat contents (<65%) with the exception of A1, F1 and G1 burgers. Chicken burgers, E1, F1 and franchise burger B had higher meat content (>65%) than the others. All beef and chicken burgers had higher 'L' values which ranged between 45.13% to 53.68% and 62.75% to 72.48% respectively except F1 which was darker. Local brands of beef burgers had a higher 'a' value compared to the franchises and all chicken burgers had a low 'a" value except F1 which was redder. Low Total Plate Count, Coliform and* E. coli *counts were detected in all burger samples.* S. aureus *counts in most local brands of beef and chicken burger samples were higher than the franchises which ranged from 2 to 11 CFU/gm sample and 6 to 22 CFU/gm sample respectively.* Salmonella *sp was not present in all burger samples.*

INTRODUCTION

An increase in the demand for fast food in Malaysia is due to the changing habits of the consumers in the 90's; it is convenient, easy to serve and eat, and suitable for those always 'on the run'. The western type of meat products which are currently adopted and manufactured in Malaysia are mostly beef and chicken burgers and frankfurters. Burgers have became one of the most popular fast food in Malaysia and there has been a rapid growth in local production of burgers in the past few years. In 1985, the giant foreign franchises were MacDonald's, Wendy's and the A&W chain of restaurants (Babji and Letchumanan 1989). This trend was followed by local producers and many franchise companies were formed such as Ramly, Yeo Hiap Seng, Purnama and Saudi. However, there are major differences between local burgers and those franchised. Differences include organoleptic properties, chemical composition, formulations, nutritional composition and overall acceptance of these burgers by consumers.

The inherent high price for premium quality animal protein have induced local producers to manufacture meat products of a lower quality for the mass consumption by the local population. Various unconventional raw materials and non-meat ingredients were utilized for further processing with only a low percentage of meat as the raw material being blended into the formulation. In processed meat production, premium meat cuts are seldom used. The utilization of unconventional raw materials and plant protein in meat products affects the chemical and nutritional composition and also the microbiological quality of the products. Under the Food Regulation of Malaysia 1985, burgers are classified as manufactured meat which must contain not less than 65% meat, 1.7% nitrogen and not more than 30% fat in organic combination. Babji et al (1984, 1985) and Babji (1988) have reported various aspects of nutritional composition, use of food binders and additives, and the processing and quality control standards in the manufacturing of local beef burgers in Malaysia. Many of the local manufacturers paid little attention to the nutritional as well as quality aspects of the products. Quality control in the processed meat industry is still unsatisfactory. There are also problems encountered in the establishment of minimum standards and specifications for such new products (Babji 1988). Information on the raw material composition, microbiological status and quality control aspects, particularly more so on the non-conventional raw materials from the livestock industry is poorly documented. The quality of locally produced and franchise burgers should be monitored from time to time to ensure that the products the minimum requirements of the standards and specifications, and are of acceptable quality to the consumers.

This study was carried out to observe the quality of the local and franchise beef and chicken burgers by determining the proximate composition, myoglobin and meat content and microbiological aspects. It is necessary to ascertain the quality of products consumed by the consumer. This study also provides information to satisfy the needs of consumers who demand meat products that are nutritions, well-balanced and safe from toxic and microbial contaminations.

MATERIALS

The analyses were carried out on six local brands of beef burgers i.e. Angus, Biffi, Fika, Ramly, Purnama and Saudi, and six local brand chicken burgers i.e. Ramly, Ayamas, Ayam Dinding, Fika, Purnama and Saudi. Most of which are available in the local supermarkets. The three types of franchise beef burgers were obtained from Mac Food Services, A&W and MBF Food Division and two types of franchise chicken burgers were obtained from Mac Food Services and MBF Food Division. The franchise burgers (beef and chicken) were labelled A, B and C and local burgers (beef and chicken) were labelled A1, B1, C1, D1, E1, F1, G1, H1 to fulfill the companies requirement for product anonymity.

The burger samples were analysed (duplicate) for proximate composition, colour in terms of lightness ('L'), redness ('a') and yellowness ('b'), myoglobin and meat content. The microbiology quality of the burger were tested by determinating Total Plate Count (CFU/gm), Coliform and *E. coli* counts (MPN/gm) *S. aureus* count (CFU/gm) and the presence / absence of *Salmonella* sp.

METHODS

Proximate Analysis

Proximate analyses were carried out using AOAC (1984) methods which included protein determination using Kjeldahl method, fat extraction via Soxhlet method, crude fibre determination using digestion with sulphuric acid, moisture determination by drying the sample for 16 - 18

hours at 100 - 102°C in oven and the ash by ashing the sample at 550°C for 9 hours in furnace oven. Carbohydrate content was determined by substracting the value from the total (100%) minus the percentages of other contents.

Physico-chemical Analysis

The lightness ('L'), redness ('a') and yellowness ('b') values for colour determination were measured using a chromameter (Minolta Chromameter Model CR - A70).

The myoglobin content was determined by using Poel Cyano Method (Topel, 1949). A 10 g sample was homogenized for 2 minutes in cold water mixed with X ml 1N H_2SO_4 in a waring blender. (X = (pH sample - 5) × 0.35). The pH of meat samples was determined using the AOAC method (1980). The homogenate was centrifuged at 3000 rpm for 2 minutes in a polyethylene tube (50 ml) using the MSE Desk centrifuge. The supernatant obtained was transferred to a 50 ml tube and heated slowly to reach a temperature of 54°C after which it was soaked in a water bath to reach 25°C. The homogenate was placed in a 100 ml beaker and the pH brought to 7.2 using Na_2CO_3. The homogenate was transferred back to a 50 ml tube and centrifuged for 10 minutes at 2500 rpm. The supernatant was filtered into a 50 ml Erlenmeyer flask and 2-3 small crystals of potassium ferricyanide was added. Absorbance was read at 540 nm using the Spectronic 20. Calculation of myoglobin (Mb) was derived by Poel-Cyano (Topel, 1949):

mg Mb / g wet tissue = absorbance × 7.50

Meat Content

The meat content for the burger samples was determined by using the myoglobin contents obtained earlier using the Poel Cyano Method (1949). A standard curve was constructed using myoglobin content of beef : soy protein or chicken : soy protein mixtures with standardized percentage of meat i.e. beef / chicken : soy ; 100/0, 80/20, 60/40, 40/60, 20/80, 0/100. The beef used in the mixtures was Indian beef as it is commonly used in the burger industry. The chicken meat used in chicken soy protein mixture was from the defatted breast meat. The soy protein used was soy protein isolate 500 E obtained from local suppliers. The meat content of the burger samples were obtained from these standard curves using their myoglobin contents which had been determined earlier.

Microbiological analysis

The following analyses were carried out using procedures described by Oxoid (1979); Total Plate Count (TPC), Coliform count (MPN), *E. coli* (MPN), *S. aureus* count and presence/ absence of *Salmonella* sp. A 10 gm sample of each material (frozen) was homogenized aseptically in a stomacher bag with 90 ml sterile Ringer solution using a stomacher (Model Seward BA 7021). The homogenous sample solution was used for the determination of Total Plate Count, Coliform, *E. coli* and *S. aureus* count. Total Plate Count was carried out using the pour plate technique, with Plate Count Agar (PCA, Oxoid) and incubated at 37°C for 48 hours. For the Coliform count, MacConkey broth media containing Neutral Red as an indicator was used. The number of presumptive positive tubes (5 tubes) were counted and refered to the MPN Table. For *E. coli* count (MPN), positive tubes from Coliform count were tested in pairs, using Eijkman test (Mac Conkey broth) and Indole test (Tryptone water). Only tubes showing positive results for both tests are considered presumptive positive for *E. coli*. For *S. aureus* count, Baird Parker Agar (Oxoid) was used which was enriched with Egg Yolk Tellurite Emulsion (Oxoid). The innoculum was spread on the surface of the agar and incubated at 37°C for 24 - 48 hours. *Salmonella* sp (25 gram sample) was isolated using pre-enriched buffered peptone water, followed by selective enrichment in Selenite Cystine Broth (SCB, Oxoid) and Tetrathionate Broth (TTB, Merck) and finally selective agar medium, Brilliant Green Agar (BGA, Oxoid) and Bismuth Sulphite Agar (BSA, Difco). The presence of *Salmonella* sp was confirmed with Triple Sugar Iron Agar (TSI, Oxoid) and Lysine Iron Agar (LIA, Oxoid).

RESULTS AND DISCUSSION

Table 1 showed the proximate composition of local brands and franchise beef burgers. From the statistical analysis, there were significant differences ($p < 0.05$) in protein, moisture and carbohydrate contents between the local brands and franchise beef burgers. However, there were no significant difference ($p > 0.05$) in fat, ash, and crude fibre contents. From Table 2, there were significant differences ($p < 0.05$) between the local brands and franchise chicken burgers in moisture, fat, protein, carbohydrate and crude fibre contents except in the ash.

TABLE 1
Proximate composition of local and franchise beef burgers

Samples *	Percentage (%)					
	Protein	Fat	Moisture	CHO	Ash	Fiber
Local :						
A1	15.51 ± 0.96	12.36 ± 1.15	57.41 ± 0.82	12.76 ± 0.03	1.63 ± 0.29	0.33 ± 0.01
B1	10.00 ± 0.71	25.74 ± 0.62	45.26 ± 0.97	16.45 ± 0.25	2.02 ± 0.12	0.53 ± 0.02
C1	11.71 ± 0.67	21.83 ± 0.84	47.16 ± 1.34	16.54 ± 0.62	2.18 ± 0.15	0.58 ± 0.02
F1	15.26 ± 2.41	17.47 ± 0.99	49.10 ± 0.72	14.78 ± 0.51	2.85 ± 0.03	0.54 ± 0.01
G1	12.70 ± 0.65	19.05 ± 0.08	55.06 ± 0.73	10.80 ± 0.63	2.08 ± 0.13	0.31 ± 0.01
H1	14.42 ± 0.84	23.38 ± 0.19	45.32 ± 0.38	14.16 ± 0.13	2.18 ± 0.17	0.54 ± 0.02
Mean	13.27 ± 1.04	19.97 ± 0.65	49.89 ± 0.69	14.25 ± 0.36	2.16 ± 0.15	0.47 ± 0.01
Franchise :						
A	18.07 ± 0.61	15.23 ± 0.36	61.61 ± 0.32	2.77 ± 0.02	1.53 ± 0.16	0.79 ± 0.02
B	21.26 ± 0.16	19.27 ± 0.42	56.89 ± 0.49	1.05 ± 0.03	0.83 ± 0.13	0.70 ± 0.02
C	20.76 ± 0.34	20.19 ± 0.17	56.42 ± 0.44	0.11 ± 0.02	2.07 ± 0.08	0.45 ± 0.01
Mean	20.03 ± 0.37	18.23 ± 0.32	58.31 ± 0.42	1.31 ± 0.02	1.48 ± 0.12	0.65 ± 0.02

* Mean of two samples/treatment

TABLE 2
Proximate composition of local and franchise chicken burgers

Samples *	Percentage (%)					
	Protein	Fat	Moisture	CHO	Ash	Fiber
Local :						
A1	12.67 ± 0.69	23.05 ± 0.66	50.81 ± 0.25	10.16 ± 0.88	1.54 ± 0.03	1.77 ± 0.09
D1	13.96 ± 1.53	12.72 ± 0.54	68.00 ± 0.34	2.06 ± 0.05	1.52 ± 0.19	1.74 ± 0.18
E1	14.38 ± 0.66	15.26 ± 0.71	64.89 ± 0.46	1.97 ± 0.32	1.94 ± 0.17	1.56 ± 0.03
F1	15.66 ± 1.25	21.02 ± 0.94	48.01 ± 1.35	11.50 ± 0.61	2.04 ± 0.05	1.77 ± 0.09
G1	13.33 ± 1.54	16.27 ± 1.00	57.82 ± 1.54	9.09 ± 0.63	1.85 ± 0.11	1.64 ± 0.06
H1	15.54 ± 0.55	23.55 ± 0.41	44.57 ± 0.61	12.53 ± 0.13	2.08 ± 0.09	1.73 ± 0.04
Mean	14.26 ± 1.04	18.65 ± 0.71	55.68 ± 0.76	7.89 ± 0.44	1.83 ± 0.11	1.70 ± 0.08
Franchise :						
A	22.74 ± 0.88	5.86 ± 0.25	68.40 ± 0.43	1.27 ± 0.03	1.32 ± 0.28	0.41 ± 0.02
B	18.20 ± 0.32	7.63 ± 0.63	66.44 ± 1.08	5.69 ± 0.03	1.69 ± 0.15	0.35 ± 0.02
Mean	20.47 ± 0.60	6.75 ± 0.44	67.42 ± 0.76	3.48 ± 0.03	1.51 ± 0.22	0.38 ± 0.02

* Mean of two samples/treatment

Franchise beef burgers had higher protein content, ranging between 18.07% to 21.26%, compared to local brands which ranged from 10.00% to 15.51%. For chicken burgers, the protein level in franchise burgers was higher than the local brands which were 22.74% and 18.20% for franchise burger A and B respectively. Some local beef burgers were found to contain high fat, (more than 21%) and carbohydrate (more than 14%) contents but lower in protein content. In local burgers with protein contents ranging from 11% to 16%, it is obvious that some of the meat protein have been replaced by binders and fillers such as rusk, breadcrumbs, cereal, legumes and soy protein. This is reflected in the higher carbohydrate contents in local burgers. This was similar with the H1, A1 and F1 chicken burgers where the fat and carbohydrate contents were more than 21% and 10% respectively and low in protein content. Babji et al. (1989) reported that manufacturers in their efforts to cut cost, often used meat substitutes such as cereals, soy proteins, ground nuts and lately mechanically deboned meat to formulate hamburgers.

For G1 beef burgers and D1 and G1 chicken burgers, although they have low protein content, their fat content was not as high as in the others. However they had a higher moisture content which were 55.06%, 68.00% and 57.82% respectively. More water could be added to the burgers with the assistance of binders and fillers such as rusk, cereals, breadcrumbs, textured vegetable protein and soy protein. The use of carbohydrate fillers add to the volume of the product since it absorbs water and binds well with the meat (Smith 1979). Carbohydrate and soy protein also aid in increasing water holding capacity of the meat product (Wilner 1979). Soy protein is popular because of its high water holding capacity, good texture and bulkiness in weight when hydrated (Babji *et al.* 1989). Although the use of soy protein in meat and meat products is strictly regulated overseas, in Malaysia, there is currently no specific regulation concerning its use in local meat products (Babji et al. 1984). Nevertheless, although the moisture level was high in franchise beef and chicken burgers including D1 and E1 burgers, the carbohydrate contents were low ranging from 0.11% to 5.69%.

Although there were no significant differences in ash and crude fibre contents in beef burgers, the local brand had a higher ash content but lower in crude fibre content when compared with franchise beef burgers A and B. This was also the same for chicken burgers, where the level of ash and crude fibre were lower in some local brands. The presence of spices for seasoning, high fibre carbohydrate, starches, cereals, legumes and soy protein could increase the ash and fibre contents in the burgers. The incorporation of mechanically deboned chicken meat in burgers also could increase the ash content due to the presence of bone particles and high calcium content. Method using myoglobin content can be used to quantitate the meat content in meat products. Its inherent variability in meat tissue is well-defined but its conversion to cyanometmyoglobin from this procedure reduces its heterogenous variability in comminuted meat samples (Babji *et al.* 1989). Figures 1 and 2 showed the standard curves plotted from the myoglobin content in the beef : soy protein, and chicken : soy protein mixtures which have standardized percentages of meat. From these curves, the meat content for all burger samples were calculated based on the

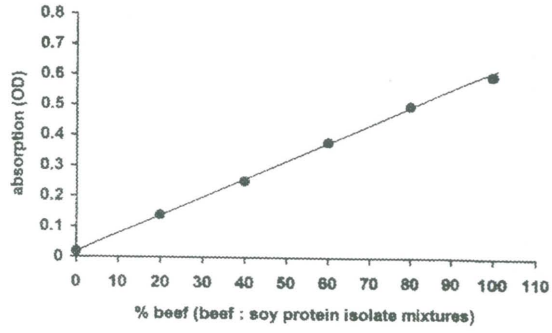

Fig. 1. Standard curve for beef burgers using beef : soy protein isolate mixture

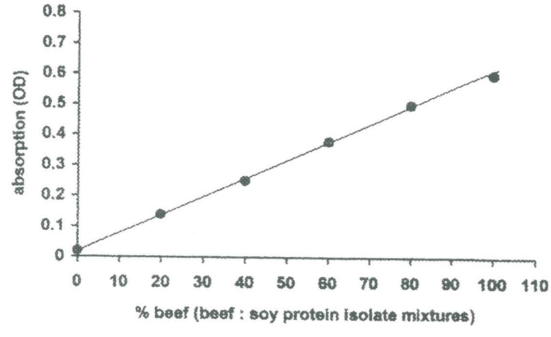

Fig. 2. Standard curve for chicken burgers using chicken meat : soy protein isolate mixture

myoglobin content. All franchise beef burgers and some local brands had lower meat contents than standard requirement (65% meat) for it ranged from 59% to 63% (Table 3). Only A1, F1 and G1 beef burgers had higher meat contents

TABLE 3
Myoglobin and meat content in local and franchise beef burgers.

Samples *	Myoglobin Content (mg/g sample)	Meat Content (%)
Local :		
A1	3.32 ± 0.19	77.25 ± 4.90
B1	2.64 ± 0.30	61.00 ± 7.27
C1	2.55 ± 0.14	59.00 ± 2.75
F1	2.86 ± 0.23	66.00 ± 5.45
G1	3.08 ± 0.20	71.38 ± 4.31
H1	2.70 ± 0.07	62.50 ± 2.20
Franchise :		
A	2.71 ± 0.36	62.13 ± 2.32
B	2.71 ± 0.04	62.13 ± 1.04
C	2.70 ± 0.05	61.98 ± 1.14

* Mean of two samples/treatment

which ranged between 66% to 77%. Low meat content in some local beef burgers could explain the low protein content in these burgers as the addition of beef fat and carbohydrate may be practised. Nevertheless, the franchise burgers also had low meat contents but had higher protein contents compared to other samples. This indicates that non-meat ingredients such as soy protein and caseinate which have high protein content could have been added. To date, most beef imported from India, usually from the fore quarters. It is even cheaper than the imported soy protein isolate and concentrate, which would lead one to believe that manufacturers would use more meat (at least 65%) so as not to contravene the food regulation. Instead manufacturers go for a formulation consisting of Indian Beef (40-60%), soy proteins (10-30%), wheat/tapioca flours, mechanically deboned meat and egg proteins to come up with the least cost (Babji *et al.* 1989).

Table 4 showed that most local brand chicken burgers and franchise chicken burger A had lower meat content (64.50%) compared to the standard requirement (65% meat). Only F1, franchise chicken burger B and E1 had high meat contents and these burgers also had high protein contents (Table 2). High protein content and low meat content in H1 and franchise chicken burger A indicated that there were addition of high protein, non-meat ingredients in the formulations.

Because of the lower amount of meat used in some local products, producers probably have to complement it with beef flavourings and colours to resemble meat. The use of food colourings in the manufacture of beef burgers is mainly to camouflage the use of fillers such as soy proteins and carbohydrates. Fresh meat colour is related to the total heme myoglobin pigment and biochemical condition (Desrosier 1977). From Table 5, no significant differences were observed ($p > 0.05$) for 'L' values but significant differences occurs for 'a' values between the local brand and franchise beef burgers. A1 and F1 beef burgers had a darker colour (high 'a' value); similar to the high myoglobin and meat contents. For 'b' (yellowness) value, there were significant differences ($p < 0.05$) between the local brands and franchised beef burgers. This high value for yellowness could be due to high fat content in the burgers.

TABLE 4
Myoglobin and meat content in local and franchise chicken burgers.

Samples *	Myoglobin content (mg/g sample)	Chicken meat (%)
Local :		
A1	2.45 ± 0.04	62.50 ± 0.09
D1	2.55 ± 0.34	64.50 ± 3.04
E1	2.65 ± 0.02	67.00 ± 0.77
F1	3.16 ± 0.15	80.63 ± 3.84
G1	2.42 ± 0.04	60.50 ± 0.48
H1	2.32 ± 0.05	58.00 ± 1.01
Franchise :		
A	2.61 ± 0.07	64.50 ± 0.02
B	2.88 ± 0.03	77.50 ± 0.95

* Mean of two samples/treatment

TABLE 5
The colour values (L-lightness, a-redness, b-yellowness) for local and franchise beef burgers

Samples *	Beef burgers		
	L	a	b
Local :			
A1	47.89 ± 0.03	+20.45 ± 0.29	+15.86 ± 0.01
B1	53.68 ± 2.53	+21.89 ± 0.56	+19.47 ± 0.33
C1	48.14 ± 1.55	+25.32 ± 1.44	+11.43 ± 0.79
F1	43.39 ± 1.20	+31.78 ± 1.37	+17.43 ± 1.48
G1	52.75 ± 0.53	+23.37 ± 0.98	
H1	51.92 ± 1.77	+23.64 ± 1.44	+15.55 ± 0.92
Franchise :			
A	52.76 ± 0.80	+6.38 ± 0.35	+16.38 ± 0.57
B	52.02 ± 1.20	+15.20 ± 1.36	+13.24 ± 0.55
C	45.13 ± 0.20	+5.38 ± 0.18	+12.57 ± 0.25

* Mean of two samples/treatment

Most of the chicken burgers had high 'L' values which ranged between 62.75 to 72.48 except for F1 chicken burgers (Table 6). F1 chicken burger was observed to have a redder colour (a higher 'a' value) compared to the other burgers. Generally there was no significant differences ($p > 0.05$) between the local brands and franchise chicken burgers for 'L', 'a' and 'b' values. Chicken meat is lighter and less red in colour than beef or Indian beef especially the breast meat. The thigh meat is redder and darker because of the muscles and high content of myoglobin.

Tables 7 and 8 showed the Total Plate Count (TPC), Coliform, *E.coli* and *S. aureus* counts for all burger samples. TPC showed that the burger samples meet the standards stipulated by the Food Regulation of Malaysia (1985) which stated that the number of microorganisms in meat and meat products must not exceed 10^6 per gram sample. TPC for local brand beef burgers was very low, in the range of 1×10^1 to 8×10^1 per gm sample. Higher TPC was found for franchise beef burgers ranging 2×10^2 to 2×10^3 per gm sample. Similarly with the chicken burgers, the franchise burgers had higher counts (9×10^2 to 2×10^3 per gm sample) than the local brands (1×10^1 to 4×10^1 per gm sample). Higher counts in the beef and chicken franchise burgers could be due to packaging and storage condition. The local brand burgers were packed in small quantities i.e. 8 to 10 pieces per pack and stored frozen. In the case of franchise burgers, large quantities were packed in a container, stored frozen and sent to the outlets or restaurants. Storing products in large quantities in containers had lower penetration of cold air to the internal part of the containers which takes a longer time to freeze. Babji *et al.* (1983) stated that the time lapse between processing, handling, transportation, storage and packaging would definitely increase chances of bacterial multiplication.

The coliform and *E.coli* counts were low for all burger samples. However, some of the franchise beef and chicken burgers had higher counts for coliform, which were 17 (MPN)/gm sample for franchise beef burgers B and C, and 27 (MPN)/gm sample for franchise chicken burger B. The Food Regulation of Malaysia (1985) stated that meat and meat product must not contained more than 50 Coliform counts per gram sample. Raw meat usually had higher coliform and *E.coli* counts, which ranged between 10^3 to 10^4 (MPN)/100 gm in Indian beef (Babji and Seri Chempaka 1994) and between 10^2 to 10^3 (MPN)/100 gm in chicken meat (Seri Chempaka and Babji 1995). Low counts in these burger samples indicated that inclusion of other ingredients and frozen storage conditions reduced the number of bacteria and retarded their growth. Chuah and Yeoh (1984) stated that *E.coli* is quite sensitive to low temperature, and freezing reduced the *E. coli* present. The growth of mesophilic bacteria like *E. coli* is retarded at low temperatures, and no growth was observed below 5°C (Barnes 1976). Mandokhot and Garg (1985) informed that coliform index has found wide use in assessing the sanitary quality of food including meats. Presence of *E.*

TABLE 6
The colour values (L-lightness, a-redness, b-yellowness) for local and franchise chicken burgers

Samples *	Chicken Burger		
	L	a	b
Local :			
A1	62.75 ± 0.76	+5.17 ± 0.35	+17.13 ± 0.82
D1	72.48 ± 0.47	+2.40 ± 0.25	+12.29 ± 0.41
E1	63.83 ± 1.21	+5.62 ± 0.35	+13.73 ± 0.82
F1	43.78 ± 1.54	+35.41 ± 0.76	+20.79 ± 0.58
G1	68.61 ± 1.20	+4.52 ± 0.28	+16.96 ± 0.23
H1	65.35 ± 1.11	+2.88 ± 0.35	+17.65 ± 0.26
Franchise :			
A	72.47 ± 0.77	+2.03 ± 0.25	+13.94 ± 0.39
B	69.53 ± 0.47	+5.55 ± 0.25	+14.13 ± 0.41

* Mean of two samples/treatment

TABLE 7
Total plate count (TPC), coliform, *E. coli* (MPN/g sample) and *S. aureus* (CFU/g sample) counts on local and franchise beef burgers.

Samples *	Total plate count CFU/g sample	Coliform count MPN/g sample (*E.coli*)	*S. aureus* count CFU/g sample
Local :			
A1	3×10^1	1(<1)	11
B1	8×10^1	1(<1)	7
C1	4×10^1	2(<1)	6
F1	1×10^1	1(<1)	2
G1	3×10^1	3(<1)	6
H1	3×10^1	1(0)	3
Franchise :			
A	2×10^3	1(0)	2
B	2×10^2	17(0)	–
C	2×10^2	17(<1)	2

* Mean of two samples/treatment

TABLE 8
Total plate count (TPC), coliform, *E. coli* (MPN/g sample) and *S. aureus* (CFU/g sample) counts on local and franchise chicken burgers

Samples *	Total plate count CFU/g sample	Coliform count MPN/g sample (*E.coli*)	*S. aureus* count CFU/g sample
Local :			
A1	4×10^1	8 (<1)	13
D1	3×10^1	2 (<1)	9
E1	1×10^1	0 (0)	6
F1	3×10^1	1 (0)	9
G1	4×10^1	7 (<1)	6
H1	3×10^1	12 (<1)	22
Franchise :			
A	2×10^3	1 (0)	-
B	9×10^2	27 (<1)	28

* Mean of two samples/treatment

coli (enterococci) is employed as an indicator of faecal pollution in food.

S. aureus counts in most local brand beef and chicken burgers were varied and higher than the franchise burgers which ranged berween 2 to 11 CFU/ gm sample and 6 to 22 CFU/gram sample respectively. DHSS United Kingdom (1989) stated that *S. aureus* in food should not exceed 10^2 per sample respectively. Fennema, Powrie and Marth (1973) reported that although freezing killed some microorganisms in food, many survived the freezing process and microorganisms that survived will grow and cause undesirable changes when the thawed food reaches a suitable temperature. The processed meat product producers must be aware of the critical control points during processing and maintain low temperature and clean sanitation during manual handling by the workers especially during processing, forming and packing the burgers. Most *S. aureus* biotype from human could produce enterotoxin (Brown 1982). *S. aureus* is a good hygienic indicator of meat base food and its presence is linked and heavy use of equipment and food handling (Shelton *et al.* 1962). In humans, the main reservoir for *S. aureus* is the nose cavity and it spreads to the skin or wound directly or indirectly (Jay 1986).

The results obtained in the study showed that there was no Salmonella sp present in all burger samples this meets the standards stipulated by the United Kingdom DHSS (1989) i.e. no *Salmonella* must be detected in 25 gram samples. Low temperature at 5°C (Alcock 1987) or lower at 4.4°C (Nickerson and Ronsivalli, 1980) could retart the growth of *Salmonella.* Principal sources of *Salmonella* are dust, food handlers, pets, insects, rodents, birds, live-haul trucks and the air. In the processing area, dust should be eliminated from the environment and equipment kept clean during the processing day. Clean-up procedures should include a sanitation programme aimed towards eliminating *Salmonella,* and should include spot bacterial checks prior to start up (Wabeck 1987). Microorganisms may pass from one raw food to another and from raw to cooked or processed foods by means of equipment, cloths and surfaces and also via people handling raw and cooked food together without realising the fact and significance of contaminated raw materials. There is much emphasis on the spread of infection from human faecal excreters to foods but little attention has been paid to the human hands passing *Salmonella* from one food to another (Hobbs and Gilbert 1970).

CONCLUSION

Results showed that there were some differences in proximate and microbiology composition between the local brand and the franchise burgers. Most franchise burgers had lower fat and carbohydrate contents and higher protein and moisture contents compared to the local brands. High fat and carbohydrate contents and low protein and meat contents in the local brand burgera showed the utilization of carbohydrate fillers/binders and addition of fat. Thus affected the colour of the product. In some local brands and franchise burgers, the utilization of non-meat protein ingredients and addition of high amount of water may have occured based the analysis of which showed high protein and moisture contents but low in fat, carbohydrate and meat contents. Absence of *Salmonella* sp, low Total Plate Count (TPC), Coliform, *E. coli* and *S. aureus* counts in the burger samples showed that the manufacturers had paid due attention to quality especially in microbiology composition by maintaining the sanitation and cleanliness of the equipment, storage facilities and workers in the processing plant. Such a study should be carried out from time to time to monitor the quality of the products in terms of nutritional value and microbiological safety.

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