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Conformity of Labeling into Real Composition of Local and Imported Chicken Burgers Sold in the State of Kuwait

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Abstract: Food authenticity is considered to be one of the most important issues that affect food quality. Food authenticity is very crucial for a country like the State of Kuwait which imports more than 90% of its processed food from countries where the processing conditions are unknown. Chicken burger has been considered as a model food for this study. Thus, the purpose of this study is to evaluate the proximate analysis, added water and hydroxyproline contents, in addition to determine any false description on the label, or substitutions of cheaper ingredients which make the chicken burgers fall short in meeting meat quality standards. Chicken burgers (local and imported) analyzed in this study were purchased from different co-operatives, fast food restaurants and retail suppliers. Proximate analysis revealed a wide variation in the composition and nutritive value among samples. Most of the local chicken burgers had higher protein ($p \leq 0.05$), meat content ($p \geq 0.05$) and moisture content ($p \geq 0.05$) and lower fat ($p \leq 0.05$) and carbohydrate content ($p \geq 0.05$) than those imported. Furthermore, both local and imported chicken burgers had high percentage of added water ($p \leq 0.05$) and hydroxyproline ($p \geq 0.05$), with respect to the standard, which give clear indication of fraudulence, as these ingredients are used to increase the size and weight of the final products without any regard to the nutritional value. Therefore, the results of the present study emphases the importance of conducting such studies to monitor and compare the quality of local and imported food products in the State of Kuwait.

Key words: Chicken burger, proximate composition, hydroxyproline, carbohydrate, total meat content, added water

INTRODUCTION

Food authenticity and adulteration have been around as long as foods have been offered for sale. By the early 1800's such problems were widespread; even though meat was not usually associated with adulteration since it was sold fresh, veal was often whitened by the addition of chalk (Hargin, 1996). An important objective of the food industry today is to produce safe and high quality food products to avoid the problem of adulterated food. Adulterated food is defined as "food incompatible with the declaration of the seller" (Montowska and Pospiech, 2011), or as "the food, which is not of the nature or substance or quality demanded by the purchaser" (Hargin, 1996). Consequently, food adulteration can take many forms such as complete or partial omission or abstraction of valuable constituents, whole or partial substitution of food components with an undeclared alternative to increase product bulk or weight or to make the product of better value than it is (Hargin, 1996). Hence, to avoid this problem the composition and labeling of processed meat and chicken have recently become an important issue worldwide as many consumers are concerned about the meat they eat, the origin of raw materials and the accurate labeling, for commercial, ethical and moral issues.

In the State of Kuwait, the adulteration of meat and chicken products is considered as a priority since the country relies solely on imported meat and meat products from many countries of the world, where the conditions of ante-mortem handling and processing are quite different and sometimes unknown. For that reason, an improved food control system for the State of Kuwait has been proposed to be in line with international and regional standards that take into consideration emerging issues such as authenticity and adulteration (Alomirah *et al*., 2010).

Therefore, the primary objective of this study is to provide a comparative study between actual sample analysis in the laboratory and the label declaration in the packaging of chicken burgers sold in the State of Kuwait.

MATERIALS AND METHODS

Sample collection: A total of 2 local and 8 imported chicken burger brands were randomly collected from

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Table 1: National and international standards for composition of chicken

	Level	
Moisture	Maximum level 60%[c]	
Fat	Maximum level 15%[b]	Maximum level 20%[c]
Protein	Minimum level 15%[c]	
Carbohydrates	Standard level 13%[a]	Maximum level 20%[c]
Ash	Standard level 1.98%[a]	Maximum level 2%[c]
Added water	Standard level 7%[d]	
Hydroxyproline	Standard level 0.08%[e]	
Meat content	Minimum level 55%[b]	Minimum level 60%[c]

[a]Meat Quality Standards, USDA (1999).
[b]Food Standard Agency UK (2003).
[c]Kuwait Standard (1187/1999).
[d]Food Standard Agency UK (Number 08/00).
[e]Food Standard Agency UK (Number 20/01)

Table 2: Labeling information for local (QL) and imported (QI) chicken burgers

Sample	Ingredients information printed on the label
QLC4	Chicken breast and chicken crumbs
QLC5	Chicken breast, milk protein, bread crumbs
QIC7	Chicken meat, water, bread flour, soya protein, vegetable oil (8.5% protein, 1% carbohydrates, 9.5% fat)
QIC8	Chicken, soya protein (3%)
QIC10	86% chicken + water + starch
QIC11	Chicken meat, soya protein, wheat flour, bread crumbs, corn oil, starch (8% fat, 20% protein, 13% carbohysdrates)
QIC12	Chicken breast meat, bread crumbs, flour, starch, vegetable protein (8% fat, 13.3% carbohydrates, 15.3% protein)
QIC13	Chicken, rusk, vegetable protein
QIC14	Chicken meat, vegetable protein (33.4% fat, 30% protein)
QIC15	Chicken, flour and bread crumbs

different Co-operatives, fast food restaurants and retail suppliers located in the six governorates in the State of Kuwait. All measurements were performed in triplicate, using a total of 30 samples for local and imported chicken burger brands.

Sample preparation: Collected samples were stored in an ice chest and immediately transported to Kuwait Institute for Scientific Research (KISR) laboratories for analysis. Chicken burgers samples were coded according to their origin as Local (QL) or Imported (QI).

Sample analysis: All the local and imported chicken burgers samples were analyzed and the results were compared with the national and international standards for the composition of chicken burgers as shown in Table 1. In addition, the products labeling information were studied and compared with the results to ensure the authenticity of the products as shown in Table 2.

Proximate analysis (moisture, crude protein, crude fat and ash contents) were analyzed according to AOAC methods (AOAC, 2000). The carbohydrates were calculated by difference. Crude protein was estimated from the total amount of nitrogen multiplied by 6.25. Fat, protein and ash were calculated as percent dry matter (%DM). For all the samples, apparent total meat contents and added water content were estimated according to TES-AC-334 method (Mclean and Turner, 2003). Hydroxyproline was determined as per TES-AC-490 method described by Drake and Hughes (2004).

Meat authenticity analysis and hydroxyproline determination

Meat content calculation: The apparent fat free meat content is calculated as follows:

$$\% \text{ Apparent FFM} = \left(\frac{\% \text{ Total nitrogen} - \% \text{ Collagen nitrogen}}{\text{Nitrogen factor}}\right) \times 100$$

FFM = Fat Free Meat.

And, the apparent total meat content is calculated as follows:

$$\% \text{ Apparent TMC} = \left(\frac{\% \text{ Total nitrogen} - \% \text{ Collagen nitrogen}}{\text{Nitrogen factor}}\right) \times 100 + \% \text{ Fat}$$

TMC = Total Meat Content.

Where:

- % Excess hydroxyproline = % hydroxyproline - 0.1% (Where: % excess hydroxyproline = zero when % hydroxyproline < 0.10%).
- % Collagen nitrogen = % excess hydroxyproline content x1.28 (Lord and Swan, 1984).
- The nitrogen factors vary with the meat concerned. However, various accepted factors have been generated by the Meat Factors Sub-committee of the Analytical Methods Committee of Royal society of Chemistry as described by Mclean and Turner in TES-AC-334 method (2003). Examples for chicken are as follows: (whole-skinless = 3.55; whole-with skin = 3.50; breast-skinless = 3.85; breast-with skin = 3.80).

Added water calculation: The amount of water added to the chicken burgers was determined by difference as Mclean and Turner in TES-AC-334 method (2003):

% Added water = 100 - (% apparent total meat content + % ash + % carbohydrate)

Statistical analyses: Data were analyzed statistically. Values of different parameters were expressed as mean ± standard deviation. Comparison of means was carried out by Duncan's multiple-range test and significance was determined at $p \leq 0.05$. Analysis was performed using SPSS software (SPSS 16.0 for Windows, SPSS Inc, Chicago, IL, USA).

RESULTS AND DISCUSSION

Labeling information of local and imported chicken burgers: Table 2 presents the ingredient information provided on the labels of chicken burgers samples. Chicken meat as the major ingredients should not be less than 55% according to Food Standard Agency (2003a). However, the percent meat was not mentioned on the labels irrespective of whether the samples were produced locally or imported with the exception of one imported sample (QIC10). Burgers mostly consist of plant-based proteins (e.g. soya bean protein isolate) and/or starch (e.g. corn starch) which are used as fillers, stabilizers and to improve the texture of the product. Presence of carbohydrates was indicated in some imported brand labels. Only two imported chicken burgers (QIC7 and 11) labels specified the use of oil (vegetable and corn oil) while others did not. Two imported chicken burgers (QIC7 and 10) declared the addition of water on the label.

Quality assessment of local and imported chicken burgers: The proximate composition, nitrogen, added water and Hydroxyproline (HP) contents of local and imported chicken burgers are presented in Table 3 and Fig. 1 and 2, respectively.

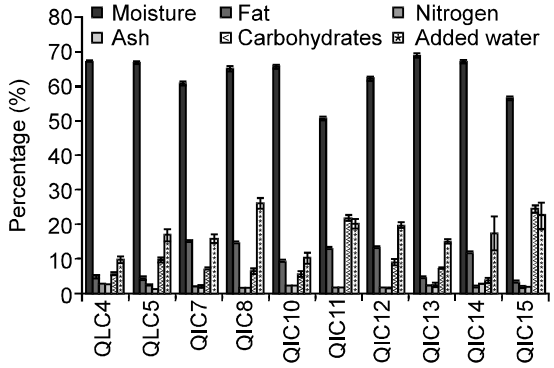

Fig. 1: Percentage of moisture, fat, nitrogen, ash, carbohydrates and added water of local and imported chicken burgers

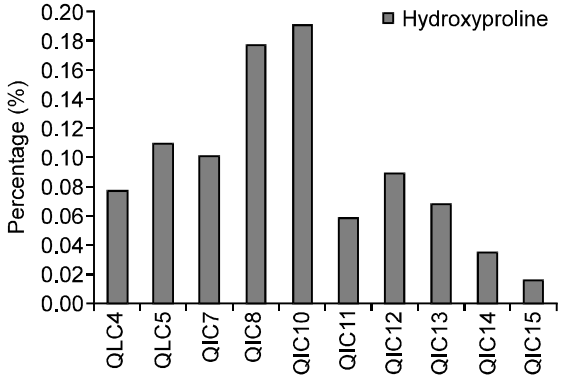

Fig. 2: Percentage of hydroxyproline of local and imported chicken burgers

Most of the chicken burger samples had the moisture content above the prescribed limit of 60% (Kuwait Standard, 1187/1999), with the exception of two imported

Table 3: Percentage of moisture, fat, nitrogen, ash, carbohydrates, added water and hydroxyproline of local and imported chicken burgers

	Percentage (%)						
Samples	Moisture	Fat	Nitrogen	Ash	Carbohydrates	Added water	HP
Local (n = 2)							
QLC4	67.23±0.16^{a*}	5.16±0.097^{a}	3.06±0.030^{a}	2.81±0.040^{a}	5.68±0.22^{a}	9.84±0.91^{a}	0.077^{a}
QLC5	66.75±0.17^{b}	4.51±0.111^{b}	2.78±0.086^{b}	1.54±0.035^{b}	9.81±0.67^{b}	16.96±1.88^{b}	0.109^{b}
Imported (n = 8)							
QIC7	60.74±0.17^{c}	15.60±0.07^{h}	2.23±0.047^{b*}	2.26±0.440^{bc}	7.42±0.22^{bc}	15.95±1.20^{abc}	0.1011^{c}
QIC8	65.05±0.87^{e}	14.71±0.12^{g}	1.91±0.050^{a}	1.84±0.010^{ab}	6.46±0.83^{b}	26.09±1.56^{d}	0.177^{d}
QIC10	65.84±0.42^{ef}	9.47±0.19^{c}	2.63±0.070^{c}	2.48±0.035^{bc}	5.77±0.69^{ab}	10.47±1.58^{a}	0.190^{d}
QIC11	50.62±0.29^{a}	13.14±0.14^{e}	1.93±0.070^{a}	2.15±0.043^{abc}	22.02±0.75^{d}	20.11±1.67^{bcd}	0.058^{b}
QIC12	62.21±0.50^{d}	13.53±0.14^{f}	2.17±0.040^{ab}	1.55±0.170^{a}	9.15±0.94^{c}	19.82±0.84^{bcd}	0.089^{c}
QIC13	68.88±0.54^{g}	4.89±0.02^{b}	2.59±0.020^{c}	2.61±0.440^{c}	7.41±0.25^{bc}	15.20±0.44^{ab}	0.068^{b}
QIC14	66.95±0.61^{f}	11.91±0.21^{d}	2.32±0.190^{b}	2.77±0.015^{c}	3.88±0.83^{a}	17.45±4.93^{abc}	0.034^{a}
QIC15	56.59±0.25^{b}	3.24±0.03^{a}	2.15±0.150^{ab}	2.19±0.030^{abc}	24.53±1.03^{e}	22.62±3.84^{cd}	0.016^{a}

^{abcdefgh}Means of the products of the same origin within the same column with different superscripts are significantly different ($p \leq 0.05$). *Values are expressed as means ± SD (n = 3). HP = Hydroxyproline

samples (QIC11 and 15). The observed high moisture content could be related to the addition of more water in the meat batter (Jimenez-Colmenero, 1996).

Fat as a major food component is used for its sensory and physiological benefits that contribute to the flavor, taste and aroma/odor of the final products (Moghazy, 1999). All the burger samples except one (QIC7) did not confer to the fat content standard as laid down by the Food Standard Agency (2003a) and Kuwait standard (1187/1999), respectively. From the present result, it was clear that the industry have used low cost fat substitute that resulted in the production of low fat chicken burgers. Even though these products are not labeled as low fat, but they serve to the benefit of large proportion of consumers. Papondina and Bloukas (1999) have justified low fat meat products due to increase consumer's health awareness in recent years. This is emphasized by the results of the present study in which all the local chicken burgers and three of the imported ones had fat contents less than 10%, which make them low fat burgers as reported by Dreeling *et al.* (2000); Suman and Sharma (2003); Troy *et al.* (1999); Turhan *et al.* (2009). The production of low fat chicken burgers can be achieved by increase in the carbohydrates and added water content that does not affect the traditional full-fat flavor, taste and texture but reduce the formulation cost (Ibrahim *et al.*, 2011) as in imported chicken burger (QIC5). Troy *et al.* (1999) used starch as a replacer in low-fat beef burger, which is a low cost fat substitute that is added to the final product due to its ability to improve water and fat binding properties, as well as, to improve cooking yields, slicing characteristics and flavors as reported by James (1992). This trend toward production of low fat chicken burgers might be a result of adulteration and the trials of the industry to reduce the cost, which make their products non-conferment with the standard.

For the nitrogen content, Kuwait Standard (1187/1999) states that the minimum level of protein in chicken burger should be above 15%, which is equivalent to 2.4% nitrogen. All the local chicken burgers fulfilled this criterion. The nitrogen incorporation could be come from other protein sources like milk protein as mentioned on the label of a local sample (QLC5). For the imported chicken burgers, six out of eight imported chicken burger samples failed to achieve the minimum protein standard as prescribed by the aforementioned standards. The lower protein content in the imported samples might be due to the replacement of proteins by other cheap ingredients. Binders and fillers like rusk, bread crumbs and plant-derived proteins are commonly incorporated in the burgers as a substitute of animal protein to reduce the cost (Babji *et al.*, 2000; Ballin, 2010). Definitely, these ingredients minimize the production cost and also enhance sensory quality but have failed to fulfill the prescribed limit for proteins (McWatters, 1990; Gehan and Emara, 2010; Serdaroglu and Degirmencioglu, 2004; Turhan *et al.*, 2007; Ray *et al.*, 1981; Das *et al.*, 2008).

Ash consists of the total minerals present in food such as sodium, phosphorus and iron that are present in the meat in the form of raw minerals, added salt and spices (Fernandez-Lopez *et al.*, 2006). All the samples of chicken burgers were above the standard ash level of 1.98% and 2% as stated by Meat Quality Standard (USDA, 1999) and Kuwait Standard (1187/1999), respectively with the exception of one local (QLC5) and two imported samples (QIC8 and 12). The importance of the high ash content come from its ability to increase the size and weight of the burgers by the activation of proteins to increase hydration and water-binding capacity (Desmond, 2006). This increased in the ash content could be achieved by the addition of spices for seasoning, high fiber carbohydrate, starches, cereals, soya-protein and salt. Incorporation of mechanically deboned chicken meat might be another factor which contributes for higher ash content (Babji *et al.*, 2000).

For carbohydrates, two imported samples (QIC11 and 15) were above the standard carbohydrate level as laid by Meat Quality Standard (USDA, 1999) and Kuwait Standard (1187/1999). This could be due to the use of cheap ingredients like rusk, bread crumbs, cereal and soya protein (Babji *et al.*, 2000; Joly and Anderstein, 2009). Plant-derived proteins (soya protein) are incorporated in the burgers due to its ability to improve the flavor and texture of the burgers by increasing the fat and moisture binding ability (Gujral *et al.*, 2002; Rentfrow *et al.*, 2004; Kassem and Emara, 2010).

For the added water content, all the chicken burger samples had added water content above the prescribed limit of 7% (FSA Number (08/00), 2000), with the exception of two imported samples (QIC7 and 10), which had declared the addition of water on the label but without mentioning the quantity. The observed high added water content in all the analyzed samples emphasize the fact that water is often used as a cheap ingredient in order to increase the size and weight of the final product (FSA, 2003b). It is not illegal to add water to the chicken burger but under European Union Regulations consumers must be notified that water has been added. Furthermore, no added water regulations exist in the State of Kuwait.

HP, is one of the hydrophilic amino acids that contribute to the sweet taste of the final products (Nollet *et al.*, 2007) and it's found in the collagen that associated with skin, bone and other connective tissue. Four imported and one local chicken burgers had HP content above the prescribed limit of 0.08% (FSA Number (20/01), 2001) as presented in Fig. 2. The observed high HP content could be contributed by the presence of hydrolyzed collagen protein as a water retaining agent (FSA, 2009) and the presence of skin or residual bone in the chicken

Table 4: Percentage of Total Meat Content (TM) and Fat Free Meat Content (FFM) of local and imported chicken burgers

	Percentage (%)	
Samples	TM	FFM
Local (n = 2)		
QLC4	81.67±1.03[a]*	76.51±0.99[a]
QLC5	71.68±2.60[b]	67.17±2.59[b]
Imported (n = 8)		
QIC7	74.36±1.40[cd]	58.75±1.35[cd]
QIC8	65.62±1.67[b]	50.90±1.55[abc]
QIC10	81.28±2.26[d]	71.79±2.44[e]
QIC11	55.71±2.46[a]	42.57±2.39[a]
QIC12	69.48±1.54[bc]	55.95±1.51[bcd]
QIC13	74.79±0.89[cd]	69.89±0.91[e]
QIC14	75.89±5.59[cd]	63.98±5.79[de]
QIC15	50.65±4.86[a]	47.41±4.88[ab]

[abcde]Means of the products of the same origin within the same column with different superscripts are significantly different ($p \leq 0.05$). *Values are expressed as means ± SD (n = 3). TM = Total Meat Content (TM); FFM = Fat Free Meat Content (FFM)

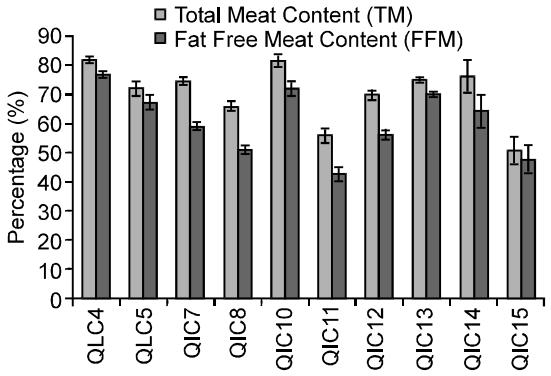

Fig. 3: Total Meat Content (TM) and Fat Free Meat Content (FFM) of local and imported chicken burgers

burgers, since skinless, boneless, lean meat in chicken products contains less than 0.08% hydroxyproline (AMC, 2000).

The Total Meat Content (TM) and Fat Free Meat Content (FFM) of local and imported chicken burgers are presented in Table 4 and Fig. 3, respectively. Food Standard Agency (2003a) and Kuwait Standard (1187/1999) stated that the minimum level of meat content should be above 55% and 60%, respectively. All the chicken burgers fulfilled the criterion with the exception of one imported sample (QIC15), which could be contributed to the presence of fat and the replacement of expensive meat protein by cheap binders and fillers (Babji *et al*., 2000). It is clear that the local chicken burgers had high meat and protein contents, which could be due to the use of chicken meat ingredients as mentioned on the label (Table 2).

Local and imported chicken burgers: An overall comparison between local and imported chicken burgers in proximate analysis, total meat contents, water contents and hydroxyproline content regardless of the brand are shown in Table 5 and Fig. 4.

Table 5: Comparison of moisture, fat, nitrogen, carbohydrates, ash, added water, hydroxyproline, Total Meat Content (TM) and Fat Free Meat Content (FFM) for local and imported chicken burgers

Parameter	LCB	ICB	Stand.
Moisture	66.99±0.31[a]	62.11±5.79[a]	60%
Fat	4.84±0.37[b]	10.81±4.37[a]	15-20%
Nitrogen	2.92±0.16[b]	2.24±0.27[a]	2.40%
Carbohydrates	7.75±2.31[a]	10.83±7.53[a]	13-20%
Ash	2.17±0.69[a]	2.23±0.43[a]	1.98%
Added water	13.40±4.12[b]	18.46±5.04[a]	7%
Hydroxyproline	0.09±0.018[a]	0.09±0.06[a]	0.08%
Total meat content	76.68±5.74[a]	68.47±10.42[a]	55-60%
Fat free meat	71.84±5.41[b]	57.66±10.36[a]	--

[ab]Means within the same raw with different superscripts are significantly different ($p \leq 0.05$). LCB = Local Chicken Burger; ICB = Imported Chicken Burger; Stand. = Standard

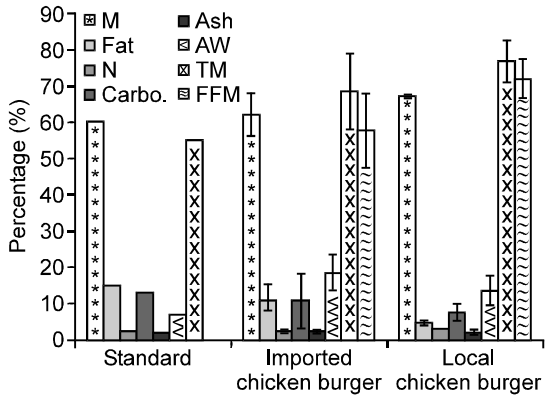

Fig. 4: Comparison between local and imported chicken burgers with the standards. M = Moisture, N = Nitrogen, Carbo. = Carbohydrate, AW = Added Water, TM = Total Meat, FFM = Fat Free Meat

The results of overall moisture content of local and imported chicken burgers showed no significant difference ($p \geq 0.05$) and were 66.99 and 62.11%, respectively. Both values were above the prescribed limit of Kuwait Standard (1187/1999). The overall fat content for the local and imported chicken burgers showed significant difference ($p \leq 0.05$) and were 4.84 and 10.81%, respectively. The values did not confer to the standard fat content as laid down by Food Standard Agency (2003a) and Kuwait Standard (1187/1999). Food regulation of Malaysia stated that the fat content in processed meat products should not exceed 30% (Food Act 1983 and Food Regulation 1985). Most of European countries regulation stated that burgers should contain at least 20-30% fat (Ramadhan *et al*., 2011). For the nitrogen content, the results showed that the overall nitrogen content for local and imported chicken burgers were 2.92 and 2.24%, respectively. The local chicken

burgers full filled the criterion stated by Kuwait Standard (1187/1999). Even though, it is higher than the limit stated by food regulation of Malaysia that requires a minimum limit of nitrogen content in processed meat products to be not less than 1.7% (Food Act 1983 and Food Regulation 1985). The overall carbohydrate contents of local and imported chicken burgers were 7.75 and 10.83%, respectively with no significant differences ($p \geq 0.05$), which did not confer to the carbohydrate content standard as laid down by Meat Quality Standard (USDA, 1999) and Kuwait Standard (1187/1999).

The overall ash content for both local and imported chicken burgers were 2.17 and 2.23%, respectively with no significant difference ($p \geq 0.05$). These values were above the prescribed limit of Meat Quality Standard (USDA, 1999) and Kuwait Standard (1187/1999).

Overall added water content of the local and imported chicken burgers showed significant difference ($p \leq 0.05$) and were 13.40 and 18.46%, respectively. The added water content for both local and imported brands was above the prescribed limit of UK Food Standard Agency. The overall Hydroxyproline (HP) content for both local and imported chicken burgers was 0.09% with no significant differences ($p \geq 0.05$). While the overall total meat content of local and imported chicken burgers were 76.68 and 68.47%, respectively with no significant differences ($p \geq 0.05$). Both values full filled the criterion stated by the Food Standard Agency (2003a) and Kuwait Standard (1187/1999). In Malaysia, the government has set a minimum requirement of meat content in manufacturing of any processed meats including burgers, to be not less than 65% (Food Act 1983 and Food Regulation 1985). In addition, most of European countries regulation stated that burgers should contain at least 80% meat (Ramadhan *et al*., 2011). Finally, the overall fat free meat content of local and imported chicken burgers were significantly differ from each other ($p \leq 0.05$) and determined to be 71.84 and 57.66%, respectively.

Conclusion: In conclusion, the results of the present study showed a significant difference in quality attributes between local and imported chicken burgers. Most of the local chicken burgers were lower in fat and carbohydrate contents and higher in protein, meat and moisture contents compared to the imported brands. On the contrary, the imported chicken burgers were higher in fat and carbohydrate contents and lower in protein, meat and moisture contents. This may be due to the utilization of carbohydrate fillers/binders and the addition of fat.

It is quite evident from our study that the food industry are non-conferment with the regulatory requirements for meat quality standards. Thus, this present study, emphasis the importance of incorporating food authenticity analyses as part of food inspection to ensure that meat and meat products are as described on the label content and are fulfilled with the prescribed limits of Kuwait and international standards.

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