

Original Research Paper

Proximate Chemical Analysis of Luncheon and Burger at Egyptian Markets

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Abstract: The inspection of the affirmed composition of meat products is a compulsory task order to protect the public benefits and health against adulteration. A total of 100 commercial meat products were purchased from different retail markets in Ismailia city for identifying their chemical criteria. The commercial meat products are beef luncheon, beef burger, chicken luncheon and chicken burger, 25 sample from each. The obtained results were compared with the Egyptian standards to estimate their acceptability. The mean values of moisture content (%) in the examined samples were 62.66, 61.02, 66.87 and 63.72 and the mean values of protein content (%) were 8.50, 11.54, 12.45 and 11.34, respectively. The corresponding mean values of fat content (%) were 5.25, 17.13, 4.65 and 8.26 and mean values of ash content (%) were 3.07, 4.01, 3.40 and 3.17. The mean values of carbohydrate content (%) were 20.49, 6.29, 12.63 and 13.49 and the mean values of meat content (%) were 26.05, 47.16, 49.67 and 44.14 for beef luncheon, beef burger, chicken luncheon and chicken burger, respectively. The correlation between protein and meat content was positive and significant ($P < 0.01$) while correlation between moisture and fat was negative and significant ($p < 0.01$). Strict supervision and periodical inspection of meat products should be carried out to ensure compliance with legal and compositional standards.

Keywords: Burger, Luncheon, Meat Analysis, Chicken, Beef

Introduction

Adulteration is a serious meat safety and quality issue which becomes the focus of attention for the food industry and consumers in the last few decades (Ahmed *et al.*, 2016). The high price of meat and passiveness of consumer safety warranty further encourage the sellers to substitute components with other replacers in the manufacturing of meat products (Roostita *et al.*, 2014). The meat products adulteration can take many forms such as complete or partial omission or substitution of valuable constituents with undeclared alternatives to increase product bulk or weight or to make the product appears of better value than it is (Hargin, 1996).

The modern technology in different fields gives chance for the meat processors to produce new products

in different shapes, easily handled, stored and rapidly used. Meat products are highly demanded due to high biological value, reasonable price and agreeable taste and easy during serving (Edris *et al.*, 2012). Prime importance in the meat industry is assuring a good quality control of the products on the market, especially of meat products to avoid the problem of adulterated food. The qualities of raw materials as well as the additives used in the final products are very important for public health. Therefore, the use of low quality ingredients in the processing yields low quality meat products (Pearson and Gillette, 1996). Meat products adulteration can be done by many ways such as complete or partial absence of valuable constituents, whole or partial substitution of components with an undeclared alternative to increase bulk or weight or to improve value (Hargin, 1996). Increases in profitability may be

achieved by adulteration to enhance the perceived quality of products, reduce manufacturing costs or for product extension purposes (Ahmed *et al.*, 2016). The detailed information on the chemical and nutritional contents is essential for consumers in choosing meat products (Erwanto *et al.*, 2012). Consequently, consumers have become more selective and more considered about the quality of the product (brand quality, consumer reviewer comments, authority frequent reports....etc.), which became a more significant factor in marketing meat products (Eman, 2009). The widespread of species adulteration in retail markets may be attributed to the inadequate meat inspection and the lack of suitable and affordable analytical methods. However, the ability to detect less desirable or objectionable species in meat products is important for people whose religious practices limit the types of meat they eat as Muslim communities who are particularly concerned about the meat they eat and the accurate labeling which is critical to detect the species that are considered not permissible to eat (Abdelmoety *et al.*, 2019; Abouelmaatti *et al.*, 2013; Farouk, 2013; Rady *et al.*, 2020; Sultan *et al.*, 2020). In addition to increased rate of adulteration with chicken meat, this may be associated with the poultry pathogen epidemiological situation in Egypt in the recent five years and emerging of new pathogens or new variant from old endemic pathogens which associated with increase mortalities in poultry farms either due to viral pathogen like infectious bronchitis, avian influenza, Newcastle virus (Ayoub *et al.*, 2019; Diab *et al.*, 2019; Elhady *et al.*, 2018; Fawzy *et al.*, 2019; Sedeik *et al.*, 2018; Sultan *et al.*, 2019a; 2019b) or bacterial pathogen like Pasteurella, e-coli and clostridium or parasite like coccidia (Eid *et al.*, 2016; 2019; Elfeil *et al.*, 2012; Enany *et al.*, 2018). Thus, identifying the species of meat in the finished meat products is the main target to fulfil Halal requirement and Islamic regulations (Hamzah *et al.*, 2014). Therefore; the chemical analysis is applied to ensure compliance with legal and compositional standards of some meat products.

Materials and Methods

Meat products quality is a critical subject and the need of further information about the composition of meat products is increased.

Collection of Samples

A total of 100 different commercial meat product samples (25 each of beef luncheon, beef burger, chicken luncheon and chicken burger) were randomly collected from local and high different retail markets located in Ismailia city and transferred under

refrigeration to the central lab, faculty of veterinary medicine to determine their chemical profiles.

Preparation of Samples

All samples were prepared and examined according to the technique recommended by AOAC (2003).

Determination of Moisture Content

Moisture Content was carried using the drying hot air oven.

Determination of Crude Protein Content

Crude protein content was measured using the Kjeldahl digestion block KJELDATHERM and VAPODEST 50s distillation systems (C. Gerhardt GmbH and Co. KG Cäsariusstraße 97, 53639 Königswinter, Germany).

Determination of Fat Content

Fat Content was estimated using the SOXTherm Manager, (cat. no. 13-0012, Gerhardt, Königswinter, Germany).

Determination of Total Ash

Ash content was measurement using a muffle furnace at 550°C.

Estimation of Total Carbohydrate Content

Total carbohydrate content was calculated as Carbohydrate% = 100 – (Protein% + Fat% + Water% + Ash%).

Calculation of Meat Content According to CCFRA (1999)

Meat content calculated by the following equation:

$$\text{Fat Free Meat Content \%} = \frac{\% \text{ Total Nitrogen} - \% \text{ Non-Meat Nitrogen}}{NF} \times 100$$

Where:

- Total Nitrogen is the total amount of nitrogen originating from the samples

$$\text{Non-Meat Nitrogen} = \% \text{ carbohydrate} \times \frac{CNF}{100}$$

(CNF = the carbohydrate nitrogen factor = 0.02)

- NF is the nitrogen factor with the appropriate type of meat for the conversion of the nitrogen content to meat content (The nitrogen factors sub – committee of the analytical methods committee of the Royal Society of Chemistry)

Statistical Analysis

Data were statistical analysis using SPSS, Version 16.0 computer program (SPSS, 2007). Least Significant Differences (LSD) at 0.05% level between means were calculated. Correlations between protein and meat content, fat and moisture were performed.

Results and Discussion

The chemical analysis indicates the nutritive criteria of the examined meat products which is important for consumer health and acceptability.

Moisture Content

Data in Table 1 showed that the mean values of moisture were 62.66, 61.02, 66.87 and 63.72% for beef luncheon, beef burger, chicken luncheon and chicken burger, respectively. No significant differences between beef luncheon and beef burger and between beef luncheon and chicken burger. But there are significant differences between chicken luncheon and all the other products.

These results are lower than those had been recorded by (Ali, 2011) in beef burger and by (Al-Bahouh *et al.*, 2012) in chicken burger and similar to those obtained by (Edris *et al.*, 2012) in beef burger and higher than those been recorded by (Edris *et al.*, 2012) in beef luncheon and by (Prayson *et al.*, 2008) in beef burger as well as by (Jecan *et al.*, 2013), (Ahmad *et al.*, 2015) and (Al-Dughaym and Altabari, 2010) in chicken burger.

As Egypt has its own legislative nutritive criteria for meat products, the samples were compared with the Egyptian standards (EOS, 2005) to estimate their acceptability. The percentages of the non-accepted samples for moisture were 52, 44, 100 and 0.0 for beef luncheon, beef burger, chicken luncheon and chicken burger, respectively (Table 1).

Multiple factors can affect the moisture content include fat percentage (inverse relationship), addition of water and non-meat ingredients and degree and type of

processing and cooking. The moisture content of a meat product is important because of the properties of water, its interaction with other components in the product and its contribution to the chemical, biological and physical properties of foods (Cornejo and Chinachoti, 2003).

Protein Content

The mean values of protein % in the examined meat products were 8.50, 11.54, 12.45 and 11.34 for beef luncheon, beef burger, chicken luncheon and chicken burger, respectively. There are significant differences between beef luncheon and the other products, while no significant differences between them (Table 2).

These results were consistent with previous reports of El-Tahan *et al.* (2006) in chicken luncheon (El-Tahan *et al.*, 2006). These results were much higher percentages had been reported by (Edris *et al.*, 2012) in beef luncheon and beef burger and (El-Tahan *et al.*, 2006) in chicken burger. On the other hand, these results were lower the results obtained by (Ali, 2011) in beef burger.

The percentage of the non-accepted samples for protein % according to the Egyptian standards (EOS, 2005) which were 96, 84, 48 and 64 for beef luncheon, beef burger, chicken luncheon and chicken burger, respectively (Table 2). The low protein content of some meat products may be due to addition of improper meat cuts or the use of meat trimmings in preparation or substitution with non-meat components, since meat proteins are relatively more expensive than non-meat components (Lawrie, 1998). Many of the protein sources used in preparing commercial products used presently are partially replaced by non-meat protein source. In addition to lowering the cost, non-meat protein sources such as egg, whey protein and soy protein, are able to improve the flavour and texture of the product by increasing the fat and moisture binding ability (Kassem and Emar, 2010). Definitely, these ingredients decrease the production cost and also enhance sensory quality but could not fulfill the prescribed limit for proteins (Turhan *et al.*, 2007).

Table 1: Mean values of moisture content in the examined meat product samples with their acceptability according to the Egyptian standards

Meat products	Mean ± SE	EOS*	Accepted Samples		Unaccepted Samples	
			No.	%	No.	%
Beef luncheon	62.66±0.84 ^{ac}	Not more than 60% EOS* (1114/2005)	12	48	13	52
Beef burger	61.02±0.81 ^c	Not more than 60% EOS* (1688/2005)	14	56	11	44
Chicken luncheon	66.87±0.44 ^b	Not more than 60% EOS* (1696/2005)	0.0	0.0	25	100
Chicken burger	63.72±0.57 ^a	Not more than 70% EOS* (2910/2005)	25	100	0.0	0.0

EOS * = Egyptian Organization for Standardization (EOS, 2005)
 Means with the same letter are not significant difference (P< 0.05).

Table 2: Mean values of protein content in the examined meat product samples with their acceptability according to the Egyptian standards

Meat products	Mean ± SE	EOS*	Accepted samples		Unaccepted samples	
			No	%	No	%
Beef luncheon	8.50±0.75 ^a	Not less than 15% EOS* (1114/2005)	1	4	24	96
Beef burger	11.54±0.71 ^b	Not less than 15% EOS* (1688/2005)	4	16	21	84
Chicken luncheon	12.45±0.45 ^b	Not less than 12% EOS* (1696/2005)	13	52	12	48
Chicken burger	11.34±0.53 ^b	Not less than 12% EOS* (2910/2005)	9	36	16	64

EOS* = Egyptian Organization for Standardization (EOS, 2005)
 Means with the same letter are not significant difference (P< 0.05).

Table 3: Mean values of fat content in the examined meat product samples with their acceptability according to the Egyptian standards

Meat products	Mean ± SE	EOS*	Accepted samples		Unaccepted samples	
			No	%	No	%
Beef luncheon	5.25±0.32 ^a	Not more than 35% EOS* (1114/2005)	25	100	0.0	0.0
Beef burger	17.13±1.58 ^b	Not more than 20% EOS* (1688/2005)	16	64	9	36
Chicken luncheon	4.65±0.39 ^a	Not more than 35% EOS* (1696/2005)	25	100	0.0	0.0
Chicken burger	8.26±0.79 ^c	Not more than 15% EOS* (2910/2005)	25	100	0.0	0.0

EOS* = Egyptian Organization for Standardization (EOS, 2005)
 Means with the same letter are not significant difference (P< 0.05)

Fat Content

The mean values of fat % in the examined meat product samples were 5.25, 17.13, 4.65 and 8.26 for beef luncheon, beef burger, chicken luncheon and chicken burger, respectively. There was a significant difference between beef burger and all the other products and between chicken burger and all the other products, while there were no significant differences between beef luncheon and chicken luncheon (Table 3).

These results were relatively lower than found by (Edris *et al.*, 2012) in beef luncheon and beef burger as well as (Al-Dughaym and Altabari, 2010) and (El-Tahan *et al.*, 2006) in chicken burger and by (Ali, 2011) in beef burger. Similar results to that were obtained by (Jecan *et al.*, 2013) in chicken burger and by (El-Tahan *et al.*, 2006) in chicken luncheon. On the other hand, These results were lower results to that obtained by (Ahmad *et al.*, 2015) and (Al-Bahouh *et al.*, 2012) in chicken burger.

By comparing the results with the Egyptian Standards (EOS, 2005), 36% of beef burger only were unaccepted based on their fat content as revealed in Table 3. The function of fat is mainly influencing the sensory quality of burgers, particularly its flavor (Suman and Sharma, 2003). 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). From the present result, it was clear that the examined products contained low cost fat substitute that resulted in the production of low-fat products. The production of low fat meat product 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). This trend toward production of low-fat meat product 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.

Ash Content

The mean values of ash % in the examined meat products were 3.07, 4.01, 3.40 and 3.17 for beef luncheon, beef burger, chicken luncheon and chicken burger, respectively. There were significant differences between beef burger and all the other products, no significant differences between beef luncheon and chicken burger and no significant differences between chicken luncheon and chicken burger.

The current results were lower the results obtained by (Edris *et al.*, 2012) in beef burger as well as by

(Al-Dughaym and Altabari, 2010), (Ramadhan *et al.*, 2011) and (Al-Bahouh *et al.*, 2012) in chicken burger. The current results were higher finding were reported by (Edris *et al.*, 2012) in beef luncheon.

The percentages of the non-accepted samples for ash % according to the Egyptian standards (EOS, 2005) were 12, 52 and 84 for beef luncheon, chicken luncheon and chicken burger, respectively as shown in Table 4. Ashes represent the total minerals found in food such as sodium, phosphorus and iron, that can be contributed by the meat as raw material, salt and spices added (Fernández-López *et al.*, 2006). The ash content in meat products not only depend on muscle minerals but also on the curing salt added (Kirk and Sawyer, 1991). The high 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 reason for increasing the ash content (Babji *et al.*, 2000).

Carbohydrate Content

The mean values of carbohydrate % in the examined samples were 20.49, 6.29, 12.63 and 13.49 for beef luncheon, beef burger, chicken luncheon and chicken burger, respectively. There were significant differences between beef luncheon and all the other products and between beef burger and all the other products. But there were no significant differences between chicken luncheon and chicken burger (Table 5).

These results were nearly consistent with previous reports of (Ramadhan *et al.*, 2011) in chicken burger. While current results were higher the results had been reported by (Abd-Elhak *et al.*, 2014) in beef burger. However, these results were lower the results were obtained by (Babji *et al.*, 2000) and (Al-Bahouh *et al.*, 2012) in chicken burger.

The Egyptian Standards (EOS, 2005) of beef burger stated that carbohydrate should not exceed 10%. The results showed that 20% of the samples were not in compliance with the Egyptian standards. Carbohydrates in burgers are mainly from the use of starches as ingredients. Starches, such as maize, tapioca, rice, potato and wheat, have been used as meat filler and water binder and this result could be due to the use of cheap ingredients like rusk, bread crumbs, cereal and soya protein (Joly and Anderstein, 2009).

Meat Content

The mean values of meat content % in the examined meat products were 26.05, 47.16, 49.67 and 44.14 for beef luncheon, beef burger, chicken luncheon and chicken burger, respectively. There were significant differences between beef luncheon and the other products which had no significant differences between them (Table 6).

These results are lower than those been recorded by (Ramadhan *et al.*, 2011) and (Al-Bahouh *et al.*, 2012) in chicken burger and higher than those been recorded by (Prayson *et al.*, 2008) in beef burger.

Table 4: Mean values of ash content in the examined meat product samples with their acceptability according to the Egyptian standards

Meat products	Mean ± SE	EOS*	Accepted samples		Unaccepted samples	
			No	%	No	%
Beef luncheon	3.07±0.11 ^a	Not more than 3.5% EOS* (1114/2005)	22	88	3	12
Beef burger	4.01±0.11 ^b	-	-	-	-	-
Chicken luncheon	3.40±0.09 ^c	Not more than 3.5% EOS* (1696/2005)	12	48	13	52
Chicken burger	3.17±0.12 ^{ac}	Not more than 2.5% EOS* (2910/2005)	4	16	21	84

EOS * = Egyptian Organization for Standardization (EOS, 2005)

Means with the same letter are not significant difference (P< 0.05)

Table 5: Mean values of carbohydrate content in the examined meat product samples with their acceptability according to the Egyptian standards

Meat products	Mean ±SE	EOS*	Accepted samples		Unaccepted samples	
			No	%	No	%
Beef luncheon	20.49±1.26 ^a	-	-	-	-	-
Beef burger	6.29±0.64 ^b	Not more than 10% EOS* (1688/2005)	5	20	-	-
Chicken luncheon	12.63±0.49 ^c	-	-	-	-	-
Chicken burger	13.49±0.66 ^c	-	-	-	-	-

EOS * = Egyptian Organization for Standardization (EOS, 2005)

Means with the same letter are not significant difference (P< 0.05).

Table 6: Mean values of meat content in the examined meat product samples with their acceptability according to the Egyptian standards

Meat Products	Mean ± SE	EOS*	Accepted samples		Unaccepted samples	
			No	%	No	%
Beef luncheon	26.05±3.84 ^a	Not less than 80% EOS* (1114/2005)	0	0	25	100
Beef burger	47.16±2.99 ^b	Not less than 60% EOS* (1688/2005)	5	20	20	80
Chicken luncheon	49.67±2.34 ^b	Not less than 80% EOS* (1696/2005)	0	0	25	100
Chicken burger	44.14±2.70 ^b	Not less than 60% EOS* (2910/2005)	3	12	22	88

EOS * = Egyptian Organization for Standardization (EOS, 2005)
 Means with the same letter are not significant difference (P< 0.05).

Table 7: Correlation coefficient between protein content and meat content

	Protein	Meat content
Protein	1	+0.986**
Meat Content	+0.986**	1

** . Correlation is significant at the 0.01 level (2-tailed).

Table 8: Correlation coefficient between moisture content and fat content

	Moisture	Fat
Moisture	1	-0.633**
Fat	-0.633**	1

** . Correlation is significant at the 0.01 level (2-tailed)

By comparing the results with the Egyptian Standards (EOS, 2005), it is evident that 100%, 80%, 100% and 88% of beef luncheon, beef burger, chicken luncheon and chicken burger, respectively were unaccepted based on their meat content which were revealed in Table 6. The low meat content of the examined products could be contributed to the presence of fat and the replacement of expensive meat protein by cheap binders and fillers (Babji *et al.*, 2000).

The statistical results showed that the Pearson's correlation between protein and meat content was positive and significant at the 0.01 level ($R^2 = 0.975$) as shown in Table 7. While Pearson's correlation between moisture and fat is negative and significant at the 0.01 level ($R^2 = -0.759$) as shown in Table 8.

Conclusion

The present study showed a significant difference in quality attributes between examined meat products. Most of them were lower in fat, protein and meat contents and higher in carbohydrate and moisture contents compared to the Egyptian Standards. It is quite evident from our study that the food industry is non-conferment with the regulatory requirements for meat quality standards.

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Author's Contributions

All authors equally contributed in this work.

Ethics

The experiment approved by Suez canal university ethical committee

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