Faculty of Veterinary Medicine

Veterinary Medical Journal-Giza (ISSN 1110-1423)
Faculty of Veterinary Medicine,Cairo University
Accredited from national authority for Quality Assurance and Accreditation
Giza, 12211, Egypt

Cairo University

Quality Attributes of Market Egyptian beef Kofta

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Abstract

A total of seventy five commercially produced frozen beef kofta were purchased from different grand hyper markets in Giza governorate. The collected samples resemble three groups (A, B & C) each contain 25 samples, where group A were the samples produced from the plants which is certified for ISO 22000 and HACCP, group B produced from HACCP certified plants while group C produced from not certified plants at all for any food safety systems. The samples were subjected to the sensory, physicochemical, chemical, deterioration criteria and bacterial attributes then the results acceptance were compared with the Egyptian standard (1973/2005) of kofta. The results revealed that group A had the lowest percentage of unacceptable samples with regard to the results of chemical compositions, deterioration criteria, bacterial loads followed by that of group B, then that of group C. However, the results of the sensory attributes and physicochemical parameters of group A were also the highest in comparing with that of group B and group C. Moreover, group A had a very high level of poly unsaturated fatty acids (PUFA) which reached 21.43% which may be due to use of plant oil as source of fat to reduce the risk of saturated fats on the human health. That's mean the factories which are certified for ISO 22000 and HACCP are seriously implementing GMP & GHP and use high quality & healthy ingredients beside commit with the legal governmental requirements.

Key wards: kofta, Meat ball, quality attributes

Introduction

The word kofta is derived from Persian kūfta which means "to grind" or meatballs ***(Serdaroglu and Degirmencioglu, 2004).*** In the simplest form, kofta consist of balls or fingers of ground beef or lamb mixed with spices and/or onions. It can be grilled, fried or baked ***(Alan, 2004).*** Some common additives are generally used during its processing to increase the water-binding capacity of the myofibrillar proteins and improve the taste of the products ***(Huda et al., 2010).***

Consumer demand for high quality convenient food products has been increased and this has led to an increase in the commercial production of meat products including meatballs in many countries all over the world. Moreover, changing consumer demands are causing the meat product manufacturing sector to embrace new ingredient systems, which is remarkable if one considers the historically traditional and long term approach to a specific product ***(Verbeke et al., 2010).***

The microbiological quality of meatball depends basically on hygienic quality of their ingredients, hygienic conditions during manufacturing and the personal hygiene. The various processing during production of meatball usually resulted in contamination with high level of various spoilage bacteria which reduces their shelf-life.

Recently, there has been a tendency for consuming meat products among the Egyptian consumers due to continuous changes in the life style. Beef meatball have become one of the choices that fulfill consumer's demands due to their high protein and carbohydrate content. Therefore, the purpose of this study was planned out to determine the different quality attributes of commercially Egyptian meatballs then compare the results acceptance with the Egyptian standard (1973/2005) of kofta.

Material and Methods

1. Samples

A total of seventy five commercially produced frozen beef kofta were collected from grand hypermarkets in Giza governorate. Samples were collected from the production of three meat processing plants (25 each), the 1st processing plant was ISO and HACCP certified, while the 2nd was HACCP certified; and the 3rd was not certified for any food safety program. Each sample was transferred immediately in cooling ice box to the laboratory of Food Hygiene and Control Department, Faculty of Veterinary Medicine, Cairo University, to investigate their quality attributes in terms of sensory, physicochemical, chemical, deterioration criteria and bacterial attributes.

2. Investigations

2.1. Sensory examination

Sensory evaluation of raw kofta samples (color, odor, marbling, forming and overall acceptability) and sensory cooked (flavor, juiciness, tenderness, palatability, overall acceptability) were assessed according to **El-Mogali et al., (1995).**

2.2 Chemical examinations

2.2.1. Proximate chemical analysis

Moisture %, protein %, ether extractable fat % & ash % were evaluated according to **(AQAC, 1995).**

2.2.2. Deterioration criteria

They include pH value **(Kandeepan et al., 2009)**, thiobarbituric acid reactive substance **(Du and Ahu, 2002)** and total Volatile Bases Nitrogen **(Kearsley et al., 1983).**

2.3. Physicochemical characteristics:

They include cooking yield % **(Pinero et al., 2008),** Moisture retention % **(EL-Magoli et al., 1995),** Fat retention % **(Murphy et al., 1975),** Diameter reduction % and Shrinkage % **(Serdaroglu and Degirmencioglu, 2004),** Water Holding Capacity % **(Hongsprabhas and Barbut., 1999).**

2.4. Bacteriological examination (APHA, 1992)

After preparation of samples homogenate, samples were analyzed for enumeration of Aerobic Plate Count, enumeration of Coliform counts, presumptive *S.aureus* count & isolation and identification of *S.aureus.*

2.5. Fatty acid analysis. (AQAC, 1995)

2.6. Statistical analysis the data were statistically analyzed according to **SAS Institute., (1996)**

Results and Discussion

Table (1): Mean values of sensory panel scores of raw market kofta (n=25)

	Processing plants categories			
	A	*B*	*C*	*Total*
Color	$2.9^{a}\pm0.85$	$2.80^{a}\pm0.13$	$2.70^{a}\pm0.1$	2.81±0.06
Odor	$3.21^{a}\pm0.85$	$2.83^{b}\pm0.11$	$2.55^{c}\pm0.76$	2.90±0.06
Marbling	$2.85^{a}\pm0.94$	$2.90^{a}\pm0.10$	$1.90^{b}\pm0.11$	2.55±0.08
Forming	$3.20^{a}\pm0.92$	$3.64^{b}\pm0.77$	$2.46^{c}\pm0.10$	3.10±0.08
Overall acceptability	$3.23^{a}\pm0.06$	$2.84^{b}\pm0.11$	$2.37^{c}\pm0.93$	2.81±0.07

*a-c: Mean with different superscript for each parameter differ significantly (P<0.05)
A= ISO and HACCP certified meat processing plant
B= HACCP certified meat processing plant
C= Not certified meat processing plant for any food safety program

Table (2): Mean values of sensory panel scores of cooked market kofta (n=25)

	Processing plants categories			
	A	*B*	*C*	*Total*
Flavor	$3.51^{a}\pm0.9o$	$2.81^{b}\pm0.15$	$2.45^{c}\pm0.10$	2.9±0.10
Juiciness	$3.51^{a}\pm0.86$	$2.82^{b}\pm0.13$	$3.06^{b}\pm0.05$	3.13±0.1
Tenderness	$3.41^{a}\pm0.77$	$2.93^{b}\pm0.11$	$2.93^{b}\pm0.05$	3.1±0.05
Palatability	$3.53^{a}\pm0.13$	$2.89^{b}\pm0.13$	$2.36^{c}\pm0.12$	2.90±0.10
Overall acceptability	$3.45^{a}\pm0.07$	$2.69^{b}\pm0.13$	$2.37^{c}\pm0.1$	2.84±0.10

*a-c: Mean with different superscript for each parameter differ significantly (P<0.05)
A= ISO and HACCP certified meat processing plant
B= HACCP certified meat processing plant
C= Not certified meat processing plant for any food safety program.

Table (3): Mean values of proximate chemical composition of raw market kofta (n-25)

	Processing plants categories			
	A	*B*	*C*	*Total*
Moisture	$59.1^{a}\pm0.65$	$59.66^{a}\pm0.80$	$61.00^{a}\pm0.60$	59.92±0.49
Protein	$13.30^{a}\pm0.40$	$12.02^{b}\pm0.24$	$12.40^{b}\pm0.22$	12.60±0.18
Fat	$13.30^{a}\pm0.46$	$13.01^{a}\pm0.65$	$14.40^{b}\pm0.86$	13.72±0.31
Ash	$3.91^{a}\pm0.77$	$4.15^{b}\pm0.05$	$3.93^{a}\pm0.10$	3.40±0.04

*a-c: Mean with different superscript for each parameter differ significantly (P<0.05)
A= ISO and HACCP certified meat processing plant
B= HACCP certified meat processing plant
C= Not certified meat processing plant for any food safety program

Table (4): Mean values of deterioration criteria of market kofta (n=25)

	Processing plants categories			
	A	*B*	*C*	*Total*
pH	$6.14^{a}\pm0.03$	$6.21^{b}\pm0.11$	$6.33^{c}\pm0.10$	6.23±0.01
TVBN	$10.92^{a}\pm0.6$	$12.81^{b}\pm0.74$	$19.61^{c}\pm0.6$	14.45±0.57
TBA	$0.49^{a}\pm0.04$	$0.97^{b}\pm0.13$	$1.08^{b}\pm0.1$	0.84±0.06

*a-c: Mean with different superscript for each parameter differ significantly (P<0.05)
A= ISO and HACCP certified meat processing plant
B= HACCP certified meat processing plant
C= Not certified meat processing plant for any food safety program

Table (5): Mean values of physicochemical characteristics of market kofta (n=25)

	Processing plants categories			
	A	B	C	Total
Cooking loss%	$28.10^{a}\pm0.8$	$29.61^{a}\pm0.80$	$33.47^{b}\pm0.30$	30.40±0.45
WHC%	$93.52^{a}\pm0.86$	$93.13^{a}\pm0.71$	$92.63^{a}\pm0.35$	93.10±93.10
Shrinkage %	$8.49^{0a}\pm0.24$	$9.90^{b}\pm0.26$	$12.01^{c}\pm0.36$	10.05±0.24
Diameter reduction%	$9.20^{a}\pm0.26$	$10.25^{b}\pm0.36$	$12.84^{c}\pm0.34$	10.70±0.26
Moisture retention%	$35.00^{a}\pm1.11$	$33.89^{a}\pm0.54$	$30.67^{b}\pm0.70$	32.84±0.50
Fat retention%	$76.70^{a}\pm1.25$	$75.53^{a}\pm1.11$	$71.40^{b}\pm1.20$	73.94±0.77

*a-c: Mean with different superscript for each parameter differ significantly (P<0.05)
A= ISO and HACCP certified meat processing plant
B= HACCP certified meat processing plant
C= Not certified meat processing plant for any food safety program.

Table (6): Mean values of bacterial counts (log10 CFU/g) of market kofta samples (n-25).

	Processing plants categories			
	A	B	C	Total
APC	5.48a±0.8	5.72b±0.99	6.32c±0.4	5.84±0.06
Coliforms	2.22a±0.57	2.05a±0.27	3.57b±0.9	2.62±0.23
S. aureus	0.37a±0.20	0.62a±0.26	0.83a±0.3	0.61±0.14

*a-c: Mean with different superscript for each parameter differ significantly (P<0.05)
A= ISO and HACCP certified meat processing plant
B= HACCP certified meat processing plant
C= not certified meat processing plant for any food safety program

Table (7): Fatty acid analysis for market kofta:

	Processing plants categories		
	A	B	C
C12:0	0.15	0.09	0.10
C14:0	3.41	2.3	3.74
C16:0	24.26	24.39	24.17
C16:1	2.56	1.77	2.42
C17:0	1.49	1.67	1.31
C17:1	0.71	0.66	0.63
C18:0	20.32	27.64	21.54
C18:1	38.18	34.62	39.17
C18:2	20.70	1.78	2.63
C18:3	0.73	0.32	0.26
C20:0	0.50	0.50	0.56
C20:1	1.05	0.03	0.20
Total unknown %	4.50	3.55	3.18
Saturated fatty acid	50.13	57.22	51.42
Mono unsaturated fatty acid	42.50	37.07	42.42
Poly unsaturated fatty acid	21.43	2.01	2.89
Total unsaturated fatty acid	63.93	39.17	45.31

A= ISO and HACCP certified meat processing plant
B= HACCP certified meat processing plant
C= not certified meat processing plant for any food safety program.

1. Sensory panel score:

Results in Table (1) indicated that the overall acceptability of raw kofta in the examined Egyptian market samples was low according to its unacceptable color, odor, marbling and forming results. The same observation was also true for cooked kofta due to the lower sensory panel scores for flavor, juiciness, tenderness and palatability (Table 2). ***Serdaroglu and Degirmencioglu (2004), Batten and Fong (2012), Peterson et al. (2014) and Saleem et al. (2014)*** reported noticeably higher sensory panel scores, while ***Bingol et al. (2013)*** and ***Serdaroglu et al. (2008)*** reported a slightly higher sensory panel scores for kofta and meat balls than those reported in this study. The results also indicated that all the investigated samples of all meat processing plants had unacceptable sensory panel scores. However, ***Torkey (2004) and Mohammed (2011)*** reported an acceptability percentage for kofta ranged from 40-73, 40-60 and 67-90%.

The obtained results also indicated the presence of significant differences ($P<0.05$) between the different processing plants concerning the investigated parameters with the processing plants not certified for any food safety program had the lowest sensory panel scores whereas ISO and HACCP certified meat processing plant showed the highest scores. These differences could be attributed to the difference in the ingredients used in formulation of the product, processing technology as well as spice mix used.

2. Proximate chemical composition:

Results of chemical analysis (Table 3) showed a slight significant difference ($P<0.05$) in protein, fat and ash with, non-significant ($P<0.05$) differences in moisture. The results also showed that, samples of category A meat processing plant were generally accepted according the Egyptian Standard Specification for kofta(1973/2005), whereas, those of category C had slightly higher moisture and fat but lower protein content, and those of category B had slightly lower protein content.

In comparison with previous data reported by different authors, it was clear that, the investigated samples had generally higher moisture but lower protein and fat content ***(Demirci et al., 2011; Oz, 2011; Çorapcı et al., 2014)*** which could be attributed to the difference in the cut of meat used in processing, use of non-meat ingredients as Mechanically deboned meat as well as use of different rates of extenders and fillers.

3. Deterioration criteria:

Deterioration criteria of kofta market samples (Table 4) indicated the presence of obvious significant differences between the samples from the different processing plants, where samples from category C meat processing plants were marginally acceptable for pH and TVBN but exceeded the permissible limit for TBA. However, samples for category B meat processing plant only exceed the permissible limits for TBA, while samples from category A plants were within the acceptable limits for all investigated parameters. The mean values

for all investigated parameters of total market kofta samples were within the acceptable limits established by the Egyptian Standard Specifications(1973/2005).

Several authors ***(Yildirim et al., 2005; Yilmaz and Dagliogla 2005)*** reported lower mean values for pH, TVBN and TBA, while some authors ***(Mohammed, 2011; Çorapcı et al., 2014)*** reported mean TBA values ranged from 0.87 to 1.57 mg malonaldehyde/kg which was obviously higher than those reported in the present study. The difference in values reported for deterioration criteria between the different processing plants as well as between the mean values in the present study and those reported by different authors could be attributed to the difference in the nature and quality of the basic raw material used, the nature and degree of saturation of the fat radical of the products, type and nature of the non-meat ingredient used as well as storage conditions.

4. Physicochemical characteristics:

Data of physicochemical attributes of beef kofta (Table 5) showed that mean values of cooking loss, WHC, shrinkage, diameter reduction, moisture retention and fat retention percentages were 30.40, 93.10, 10.05, 10.70, 32.84 and 73.94%, respectively with significant differences between the different processing plants. ***Ulu (2006)*** reported that, the mean values for cooking yield, fat retention, moisture retention and shrinkage percentages in Turkish type meatballs were 63.93, 42.95, 35.06 and 27.71%, respectively. However, several authors ***(Peterson et al., 2014; Serdaroglu and Degirmencioglu, 2004; Sengun et al., 2014)*** reported different values which could be attributed to difference in formulation of the product, difference in fat and protein levels and processing technology.

Cooking yield is considered as one of the most important factor for meat industry in predicting behavior of meat products during processing ***(Pietrasik and Li-Chan, 2002, Ulu (2006).*** Data of cooking loss percentage revealed that, samples of all processing plants were very high especially in the third one. This high cooking loss may be correlated with using of raw meat material with low binding ability which in turn results in low moisture and fat binding. The decrease in cooking yield in different samples could be explained on the findings of ***Ikhlas et al., (2011)***. That products tend to shrink during cooking process due to the denaturation of the meat proteins, with the loss of water and fat.

Water holding capacity is generally related to the weight loss and final quality of product. In this respect, the obtained data cleared that samples of the 3rd category showed the lowest WHC% as well as the highest cooking loss percentage. In accordance with results of cooking loss and WHC percentages the data of diameter reduction, shrinkage percentage, moisture retention and fat retention percentages showed that samples from category B and C had significantly higher values for the 1st two

parameters and significantly lower values for the last two parameters than that of A. Once more these differences could be due to the difference in the raw meat material. ***Field (1988)*** established that, presence of connective tissue, in which the main protein is collagen, decreased water holding capacity when heated at temperatures of 60-65°C, causing shrinking and diameter reduction.

5. Bacteriological quality:

It was obvious from data of bacteriological examination that samples from ISO and HACCP certified processing plant had significantly lower bacterial load and those from non-certified plants had significantly higher counts (Table 6). Moreover, the overall mean for investigated organisms were unacceptable according to the Egyptian specifications(1973/2005), where the mean values were 5.84, 2.62 and 0.61 $\log_{10}$ CFU/g for aerobic plate, coliforms and *S. aureus* counts respectively. ***Musleh et al. (1985)*** established that raw kofta had the highest total viable bacteria and coliforms count among the Egyptian meat products. However, several authors (***Bingol et al., 2013; Can et al., 2013; Çorapcı et al. , 2014; Sengun et al., 2014)*** reported different values for meatballs and kofta which may be due to differences in hygienic condition during processing, degree of contamination of raw materials as well as processing conditions and storage.

Fatty acid analysis of beef kofta (Table 7) revealed samples from category A had a very high level of poly unsaturated fatty acids (PUFA) which reached 21.43% and was mostly from C18:2 fatty acid (20.70), a matter which may be due to use of plant oil as source of fat to reduce the risk of saturated fats on the human health. Concerning the saturated fats, it was also evident that C16 fatty acid was the most prevalent one followed by C18. However, ***Yılmaz and Daglioglu (2003), Yilmaz (2004) and Yilmaz and Daglioglu (2005)*** reported higher saturated but lower mono- and poly-unsaturated fatty acid contents, while ***Yilmaz (2005)*** reported lower saturated and higher unsaturated fatty acid composition with contents of 50.3 43.6 and 6.1 for saturated; monounsaturated and polyunsaturated fatty acids respectively.

It could be concluded that processing plants which are certified for food safety management system ISO 22000 and/or HACCP are more commit to the legislative specification, use high quality of raw materials, implement good manufacturing practice, good hygienic practices and keep consumers health.

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الملخص العربى

تم فحص عدد خمسه وسبعون عينة من الكفته البقرى تم تجميعها بصورة عشوائية من المحلات الكبرى المتخصصة في عرض مصنعات اللحوم، وقد تم تقسيمها الى ثلاثه مجموعات،المجموعه الاولى منتجة من مصانع حاصله على الايزو 22000 والمجموعه الثانيه منتجة من مصانع حاصله على الهاسب والمجموعه الثالثه منتجة من مصانع لا تطبق اى برنامج لامن وسلامه الغذاء.جميع العينات تم تقيمها من الناحيه الحسيه, كيميانيا, دلالات الفساد,فيزوكيميانيا,بكتريولوجيا مع مقارنتها بالحدود المقبوله للمواصفه القياسيه المصريه للكفته(1973/2005) بالاضافه الى قياس نسبه الدهون المشبعه والغير مشبعه.

أظهرت النتائج ان المجموعه الاولى تحتوى على اقل نسبه من النتائج الغير مقبوله بالنسبه للفحص الكيميانى, دلالات الفساد,العد البكتريولوجى بالاضافه الى احتوائها على نسبه ضئيله من الدهون المشبعه بينما احتوت نفس المجموعه على نسبه عاليه من العينات المقبوله حسيا واختبارات الفيزوكيميانيا عند مقارنتها بالمجموعه الثانيه والثالثه.وهذا يدل على ان المصانع المطبقه لنظم امن وسلامه الغذاء تطبق اساليب تصنيع جيده, تستخدم مواد خام جيده واكثر التزامنا بالقوانين وصحه المستهلك.