

CHEMICAL AND MICROBIOLOGICAL CHARACTERISTICS OF SOME MINCED MEAT SAMPLES COLLECTED FROM LOCAL MARKET OF MANSOURA CITY

Hassan, A. M. ; Sh. M. M. El-Shehawy and M. M. M. Rabie
Food Industries Dept., Fac. Agric., Mans. Univ., Egypt

ABSTRACT

This present manuscript was carried out to be ensured that the collected samples of minced meat from local market of Mansoura city are accordant minced meat Egyptian Standard Specification or not.

From obtained results, fat content of minced meat samples ranged from 17.48 to 21.94%, while the highest protein content (22.19 %) was recorded for M₃ sample. Total volatile nitrogen of the three minced meat samples did not exceed 20 mg/100 g. In addition, total soluble nitrogen (TSN) values of minced meat samples ranged from 21.59% to 26.48% as percentage of total nitrogen. Furthermore, non protein nitrogen (NPN) of minced meat samples ranged from 5.01% to 7.45% of total nitrogen and 23.1% to 28.1% of total soluble nitrogen. At last, free amino nitrogen (FAN) values varied from 11.63% and 14.33% of total nitrogen.

The highest acid value (AV) in minced meat samples was 5.53 mg KOH/g for M₃. As for oxidative rancidity, peroxide values (PV) of minced meat samples ranged between 19.33 to 29.69 mliequivalent O₂/kg fat for M₂ and M₃ samples, respectively. Saturated fatty acids in minced meat fat ranged from 50.3% to 51.35% from total fatty acids, while total unsaturated fatty acids in minced meat samples fat were in between 47.96 % and 49.82%, where monounsaturated fatty acids ranged from 45.2 % to 46.61%, while polyunsaturated fatty acids percentage ranged between 1.99 % and 4.62%.

For the M₃ sample, the total bacterial count using NA cultivation medium showed to be the highest value being 0.529×10^6 cfu/g, followed by M₁ and M₂ samples (0.292×10^6 and 0.021×10^6 cfu/g, respectively).

In conclusion, the present study has clearly indicated that all collected minced meat samples were chemically in accordance with the Egyptian Standard Specifications (2005) but from microbiological view, only M₂ sample was safe.

So, Minced meat purchased from local market of Mansoura city could be considered as a safe food for human consumption, but there is a need for good handling and storage conditions to reduce microbiological contamination and growth of microorganisms.

Keywords: Minced meat, chemical characteristics, protein fractions, fat indices, fatty acids and microbiological aspects.

INTRODUCTION

Meat and meat products are essential components in the diets of human being. Their consumption is affected by various factors. The most important ones are product characteristics such as sensory, nutritional properties, safety, price, religion and convenience. The consumer and environment-related ones like psychological, health, family or educational aspects, general economic situation, climate, and legislation, etc. are usually

closely linked to social, economic, political and geographical aspects. (Jiménez-Colmenero *et al.*, 2001).

Meat products particularly the minced meat is highly perishable foods. Therefore, great care is necessary over the entire period from processing date till the consumption time. Such meat products require freezing accommodation during storage, distribution, marketing and handling until reaching the consumer. (Tolba, *et al.*, 1994).

Minced meat is the output of mincing the fresh or frozen meat without adding any fillers, preservatives or improvers and packaged in containers suitable for keeping cold and frozen.

The Egyptian Organization of Standardizations EOS,(2005) for frozen meat restricted the moisture content of minced meat to 70% or less, protein content should not be less than 18% and fat content has to be 20% or less. Thiobarbituric acid (TBA) value should not exceed 0.9 mg malonaldehyde/kg meat. As for microbiological aspects, clostridium count in minced meat should not exceed 10^2 cfu/g, total bacterial count of minced meat should not exceed 10^6 cfu/g. On the other hand, staphylococcus should be less than 10^2 cfu/g and shouldn't have salmonella or shigella.

Ouf (2004) studied forty samples of frozen camel meat products (10 samples for each of burger, kofta, minced meat and sausages) collected from different supermarkets in Cairo and Giza governorates, which subjected to bacteriological evaluation. The incidence rate of *E.coli*, *Salmonella sp.* and *Staphylococcus aureus* in examined minced meat samples were 20%, 0%, 20% and 10% of total count, respectively. *Shigella sp.* failed to be detected in all examined camel meat products.

According to United State Department of Agriculture (USDA), (2010), fatty acids composition in minced meat were 34.71%, 53.98% and 11.30% for saturated, monounsaturated and polyunsaturated fatty acids, respectively. Where, palmitic and stearic acids represented 22.45%. And 10.84%, respectively. While oleic acid and linoleic acid were 50.52% and 10.38%, respectively.

So, this study was carried out to make sure that if these collected minced meat samples from local market of Mansoura city are accordant minced meat Egyptian Standard Specification or not. And also, try to establish that these samples were safe for human consumption and in high quality for human nutrition.

MATERIALS AND METHODS

Materials:

Mansoura city was divided into three different districts. From each district three main marked (main meat production companies) minced meat samples were chosen. Five packs were collected for each chosen marks.

Chemicals and media used for the following examinations were obtained from El-Gomhoria Company.

Methods:

All samples were maintained into ice box to the laboratory, then the five collected minced meat samples were mixed and homogenized to obtain a representative sample for each mark.

All aforementioned prepared samples were packaged into polyethylene bags and stored at -18° C up to chemical analysis. And for microbiological examinations, three samples of each mark were microbiologically tested and then means were scored.

Chemical analysis:

Moisture, crude protein, crude fat, ash and salt contents were determined using AOAC, (2005) methods.

Carbohydrates content was calculated by difference.

Energy value: It was calculated as follows:

$$\text{Energy value} = \text{carbohydrates \%} \times 4.1 + \text{protein \%} \times 4.1 + \text{fat \%} \times 9.3$$

Water activity (a_w) was theoretically calculated from the determined moisture and salt content using the following equation according to (Demeyer, 1979).

$$\text{If } X < 0.1775, a_w = 1.0014 - 0.6039x.$$

$$\text{If } X > 0.1775, a_w = 1.0288 - 0.7614x.$$

Where: X = NaCl % / Moisture %.

pH value was measured according to the method of Lima Dos Santos *et al*, (1981) using pH meter (Hanna instruments pH 213 Microprocessor pH meter).

Total volatile nitrogen (TVN) was determined according to the method mentioned by Pearson (1968). Total volatile bases nitrogen was calculated as mg nitrogen per 100 gm sample.

Non-protein nitrogen (NPN) was determined according to the method of (Durand, 1982).

Total soluble nitrogen (TSN) was determined according to the method of (Soloviev ,1966).

Free amino nitrogen (FAN) was determined as explained in the (AOAC, 2005).

Fat was extracted from minced meat samples by grinding using an electrical blender and then soaking it in Hexan 60-80 °C overnight, then the micelle was filtered and then all separated fat samples were dried by anhydrous sodium sulphate evaporated under vacuum at 40°C to separate the solvent and kept into dark bottles under freezing at -18° C until analysis.

Iodine value (IV) test was carried out as described by AOAC, (2005) by using Hanns solution and it was expressed as g I/100 g fat.

Peroxide value (PV) for all extracted fat from minced meat samples was determined according to the method described in AOAC, (2005). The PV was expressed as mliequivalent peroxide/kg fat.

Acid value (AV) for extracted fat from minced meat samples was carried out according to the method of AOAC, (2005) and was expressed as mg KOH/g fat.

Free fatty acids content (FFAs %) was calculated from a formation determined using in (AV) and applying the following equation, according to AOAC, (2005) :

FFA% = acid value × 0.503 and expressed as oleic acid.

Thiobarbituric acid value (TBA) was determined as described by Tarladgis *et al.* (1960). TBA value was expressed as mg malonaldehyde/Kg fat using the following equation:

$$TBA = 7.8 \times O.D$$

O.D = Optical Density at 538 nm (absorbency).

The methyl esters of extracted fat were prepared according to the method described by (AOAC, 2005).

Gas liquid chromatography was used for determination and identification the fatty acids methyl esters in central lab of Food Technology Research Institute (FTRI), according to the method described by Zygadlo *et al.* (1994).

Microbiological evaluation:

Minced meat sample bags were aseptically opened and 10 gm of sample were taken and completely minced in porcelain dish, then transferred to 90 ml of sterile water. The suspension was shaked by hand for 5 minutes to prepare a 1:10 dilution. Further dilutions were prepared as needed and plated in duplicate.

Plate counts were performed on nutrient agar medium. After serial dilutions and inoculations, plates were incubated at 30° C for 48 hours before counting according to Gilliland *et al.*, (1976). The average of triplicate readings was scored.

Coliform Counts were estimated based on most probable number (MPN) procedure technique using Mc crady's tables for calculating the presumptive number. Mac-Conkey broth was preparing by adding 40 g to 1 liter of distilled water. Mix well and distribute into containers fitted with fermentation (Durham) tubes. Sterilize by autoclaving at 121°C for 15 minutes. distributed in 10 ml quantities in test tubes containing inverted Durham tubes. This medium was prepared according to the (Oxoid manual, 2006).

For detecting and enumerating *Staphylococci*, appropriate dilutions of meat samples were carried out and then planted with *Staphylococcus* medium No.110 (Difco, 1974).

Total salmonella and shigella colonies were counted following the method of (Miyamoto *et al.*, 1997)

Dilution frequency determinations is a technique was adopted to determine the densities of anaerobic spore forming clostridia , using selective liquid media, 5 tubes for each dilution. The inoculated tubes were sealed with sterile mixture of Vaseline and Paraffin was (1:1) and incubated at 30 C for 21 days. The presence of clostridia was detected at the end of the incubation period by the accumulation of gases pushing the vaspar layer up as described in modified Winogradsky's Allen, (1959) medium.

RESULTS AND DISCUSSION

Approximately chemical composition of collected minced meat samples were shown in Table (1). Moisture contents ranged from 57.02 to 63.58% in all minced meat samples, as for fat content M₁ sample scored the least value which represented 17.48%, while M₂ and M₃ samples were 21.94% and 19.94%, respectively. The first sample was not in compatible with EOS, (2005) while the other samples were in accordance with it (20%).

The highest protein content (22.19%) was observed for M₃. The protein content of all minced meat samples was in accordance with EOS, (2005) which included that the protein content must not be less than 18%.

Generally, the exceeding of moisture content in minced meat samples, descend the protein and fat contents. Therefore, the highest moisture content (M₁) showed the lowest energy value (233 k cal. /100 g).

Table (1): Approximately chemical composition of collected minced meat samples:

Samples	Moisture%	Ash %		Crude Protein%		Crude Fat %		Carbohydrates%	Energy value K calorie /100 g
		W.B.	D.B.	W.B.	D.B.	W.B.	D.B.		
M ₁	63.58	0.85	2.33	17.79	48.84	17.48	47.99	0.3	233
M ₂	59.54	0.65	1.61	17.75	43.87	21.94	54.23	0.12	273
M ₃	57.02	0.83	1.93	22.19	51.63	19.94	46.39	0.2	273

From the same Table, it could be noticed that, the highest ash content (0.85%) was recorded for M₁ sample, followed by 0.83% and 0.65% for M₃ and M₂ samples, respectively.

As for carbohydrate content, which naturally represent a small proportion of minced meat composition where, it ranged from 0.12 to 0.3%.

NaCl%, water activity, pH and acidity% are shown in Table (2). From tabulated data, it could be noticed that NaCl% ranged from 0.42 to 0.71 and a_w were 0.9949, 0.9976 and 0.9975 for M₁, M₂ and M₃ samples, respectively.

Furthermore, pH values of different minced meat samples ranged from 5.8 to 6.2. Total acidity as lactic acid were 0.76, 0.56 and 0.65% for M₁, M₂ and M₃ samples, respectively.

Although M₁ sample had the highest value of pH, it had the highest value of acidity percentages. This observation could be explained that pH refers to effect of active hydrogen of cation on glass electrode of pH meter but, acidity percentage reflects the total hydrogen measured by alkaline titration.

Table (2): NaCl %, water activity (a_w), pH value and total acidity % (as lactic acid) of collected minced meat samples:

Samples	NaCl %		a _w	pH	Acidity %
	W.B.	D.B.			
M ₁	0.71	1.95	0.9949	6.2	0.76
M ₂	0.42	1.04	0.9976	6.1	0.56
M ₃	0.48	1.12	0.9975	5.8	0.65

Of course, such NaCl and water activity values did not help to preserve this product from spoilage or deterioration by microorganisms or enzymes. So, this meat samples must be kept at -18°C.

Protein fractions of collected minced meat samples and the percentages of these nitrogenous compounds of total nitrogen were tabulated in Tables 3 and 4.

Table (3): Protein fractions of collected minced meat samples:

Samples	TVN mg N/100g	TSN %	NPN %	FAN %
M1	14.77	0.75	0.21	0.41
M2	4.06	0.76	0.19	0.40
M3	14.91	0.77	0.18	0.41

Table (4): percentage of protein fractions of collected minced meat samples.

Samples	TN	TVN/TN %	TSN/TN %	NPN/TN %	FAN/TN %	NPN/TSN
M1	2.85	0.52	26.48	7.45	14.33	28.1
M2	2.84	0.14	26.77	6.59	14.19	24.5
M3	3.55	0.42	21.59	5.01	11.63	23.1

Total volatile nitrogen (TVN) values of different minced meat samples ranged from 4.06 (M₂) to 14.91 (M₃) mg/100g as given in Table 3. These values did not exceed the permissible limit of the EOS, (2005) which reported that, total volatile nitrogen of frozen minced meat must not be more than 20 mg/100 g. In addition, total soluble nitrogen (TSN) values ranged from 21.59 to 26.48% as percentage of total nitrogen.

Non protein nitrogen (NPN) of minced meat samples ranged from 5.01% to 7.45% of total nitrogen and 23.1% to 28.1% of total soluble nitrogen. At last, free amino nitrogen (FAN) values varied from 11.63% and 14.33% of total nitrogen.

These aforementioned results indicated that despite of protein hydrolysis was very low, the first sample of minced meat (M₁) was in the first order of protein breakdown.

Data given in Table (5) indicate minced meat fat indices. The higher acid values (AV) in minced meat samples was 5.53 for M₃. Consequently free fatty acids percentage (FFA %) was 2.78% as oleic acid. Acid value of samples M₁ and M₂ were 4.22 and 3.14, respectively, and consequently FFA% were 2.12 and 1.58 % as oleic acid, respectively. So, these acid values referred to hydrolytic rancidity caused by lipase enzyme.

Table (5): Fat indices of collected minced meat samples:

Samples	Acid value (AV) mg KOH/g	Free Fatty Acids % As Oleic acid	Peroxide value (PV) "mlequivalent O ₂ / Kg fat	Iodine value as g I/100 g fat	Thiobarbituric acid (TBA) "mg malonaldehyde / kg sample
M1	4.22	2.12	22.34	40.63	0.46
M2	3.14	1.58	19.33	44.44	0.31
M3	5.53	2.78	29.69	29.96	0.22

As for oxidative rancidity, peroxide values (PV) of minced meat samples ranged between 19.33 to 29.69 for M₂ and M₃, respectively.

Malonaldehyde contents measured by the TBA procedure were 0.46, 0.31 and 0.22 mg malonaldehyde / kg sample for M₁, M₂ and M₃ samples, respectively. TBA values of all examined minced meat samples did not exceed the admissible limits by EOS, (2005), which mentioned that TBA value of minced meat samples must not be more than 0.9 mg malonaldehyde / kg sample. These results indicated that there is no oxidative rancidity in minced meat samples was detected.

Iodine values (IV) ranged between 29.96 and 44.44, these results refer to the nature of meat fat who characterized with high level of unsaturated fatty acids.

In regard to protein fractions and fat indices results, it could be concluded that all minced meat samples should be stable against protein breakdown and fat deterioration.

Data tabulated in Table (6) showed that the values of saturated fatty acids in minced meat fat ranged from 50.3% to 51.35% from total fatty acids, Taking into consideration predominance both palmitic and stearic acids, which they ranged from 26.87 to 26.96 and 17.83 to 20.35% respectively.

Table(6) also showed that total unsaturated fatty acids in minced meat samples fat were in between 47.96 % and 49.82%, where monounsaturated fatty acids ranged from 45.2 % to 46.61%, oleic acid was the highest monounsaturated fatty acid (40.86% - 42.16%) , while polyunsaturated fatty acids percentage ranged between 1.99 % and 4.62%, which represented as linoleic acid (1.42 % – 3.94 %).

Table (6): Fatty acids composition of minced meat samples:

Fatty acids	Minced meat samples		
	M ₁	M ₂	M ₃
(Merestic) C _{14:0}	4.04	3.90	3.15
(Palmetic) C _{16:0}	26.96	26.87	26.27
C _{17:0}	0.73	0.97	0.86
(Stearic) C _{18:0}	17.83	18.66	20.35
C _{20:0}	0.57	0.79	0.72
TSFA	50.13	51.19	51.35
C _{16:1}	2.60	3.28	2.73
C _{17:1}	1.35	1.33	1.39
(oleic) C _{18:1}	41.25	40.86	42.16
C _{20:1}	-	0.44	0.33
MUFA	45.20	45.91	46.61
(linoleic) C _{18:2}	3.94	1.66	1.42
(linolenic) C _{18:3}	0.68	0.39	0.57
PUFA	4.62	2.05	1.99
TUFA	49.82	47.96	48.6
TUFA/TSFA	0.99	0.94	0.95

USFA/SFA for minced meat samples fat registered 0.99, 0.94 and 0.95 for M₁, M₂ and M₃, respectively. Total unsaturated fatty acids values were compatible with iodine values. So, all studied samples could be considered a moderate biological value of fat.

Presented results in Table (7) show the microbiological evaluation of the studied minced meat samples. For the M₃ sample, the total bacterial count (T.C.) using Nutrient Agar (NA) cultivation medium showed the highest value being 0.529×10^6 cfu/g for M₃ sample, followed by M₁ and M₂ samples (0.292×10^6 and 0.021×10^6 cfu/g, respectively).

The same results showed that, in case of *Salmonella* and *shigella* values, M₁ showed the most contaminated one being 0.014×10^3 cfu/g followed by M₂ sample (0.002×10^3 cfu/g), while M₃ sample was free from *salmonella* or *shigella* bacteria. In addition, in case of *staphylococcus* all samples were free. The *E. coli* test showed the highest value in M₃ sample as 0.032×10^3 cfu/g while other samples were free.

Table (7): Microbiological evaluation of collected minced meat samples:

Samples	Microbiological test (CFU/g) sample				
	T.C.	S.S.	Staph.	E.Coli	Clost.
M ₁	0.292×10^6	0.014×10^3	-	-	7.6×10^2
M ₂	0.021×10^6	0.002×10^3	-	-	1.9×10^2
M ₃	0.529×10^6	-	-	0.032×10^3	9.7×10^2
EOS	10^6	free	10^2	No limit	10^2

From results showed in Table (7), the clostridium test showed to be the slightly high in all minced meat samples, where it was 1.9×10^2 cfu/g in M₂ sample and this value was within the permissible limit (10^2). But, M₁ and M₃ samples contained higher number of spore forming bacteria, reached 7.6×10^2 and 9.7×10^2 cfu/g, respectively.

Conclusion

In conclusion, the present study has clearly indicated that all collected minced meat samples were chemically in accordance with EOS, (2005) but only M₂ sample was safe from microbiological view. Minced meat collected from local market of Mansoura city could be considered as a safe food for human consumption, but there is a need for good handling and storage conditions to reduce microbiological contamination and growth of microorganisms.

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الخصائص الكيماوية و الميكروبيولوجية لبعض عينات اللحم المفروم بالسوق المحلي لمدينة المنصورة
أبو بكر محمد حسن ، شادي محمد محمود الشهاوي و محمد ممدوح محمد ربيع
قسم الصناعات الغذائية - كلية الزراعة - جامعة المنصورة - مصر

تم اجراء هذه الدراسة بغرض التأكيد من مدى توافق عينات اللحوم المفرومة المتداولة والمستهلكة في مدينة المنصورة مع المواصفات القياسية المصرية. وكذلك في محاولة للتحقق من أن هذه العينات آمنة و ذات جودة مناسبة لتجذبة الإنسان. لذلك تم تجميع ثلاثة عينات من اللحم المفروم من مدينة المنصورة (خمسة مكررات). كل عينة تمثل شركة منتجة للحم المفروم.

ومن مناقشة النتائج أمكن تقرير أن محتوى الدهون في العينة M_1 سجل أقل قيمة وهو ما يمثل ١٧,٤٨ % ، في حين تم تسجيل أعلى نسبة البروتين (٢٢,١٩ %) للعينة M_3 . أما بالنسبة للنيتروجين الكلى المتتطابق للثلاثة عينات من اللحم المفروم فلم يتجاوز قيمة ٢٠ ملجم / ١٠٠ جرام . وبالإضافة إلى ذلك ،يتراوح النيتروجين الكلى الذائب لعينات اللحم المفروم من ٢١,٥٩ إلى ٢٦,٤٨ % كنسية مئوية من مجموع النيتروجين الكلى. وعلاوة على ذلك تراوحت قيم النيتروجين الغير بروتيني في عينات اللحم المفروم من ٥,٠١ % إلى ٧,٤٥ % من النيتروجين الكلى و ٢٣,١ % إلى ٢٨,١ % من النيتروجين الكلى الذائب.

أما بالنسبة للنيتروجين الأميني الحر فقد تراوحت القيم من ١١,٦٣ % إلى ١٤,٣٣ % من إجمالي النيتروجين. وكانت أعلى قيمة لرقم الحامض في عينات اللحم المفروم (٥,٥٣) للعينة M_3 . أما بالنسبة للتزنج التاكسدي ، تراوحت قيم رقم البيروكسيد في عينات اللحم المفروم بين ١٩,٣٣ إلى ٢٩,٦٩ للعينات M_2 و M_3 ، على التوالي. تراوحت الأحماض الدهنية المشبعة في دهن اللحم المفروم بين ٥٠,٣ % إلى ٥١,٣٥ % من مجموع الأحماض الدهنية ، في حين أن مجموع الأحماض الدهنية غير المشبعة في عينات دهن اللحم المفروم تراوحت بين ٤٧,٩٦ % و ٤٩,٨٢ % ، حيث تراوحت الأحماض الدهنية احادية عدم التشبع بين ٤٥,٢ % إلى ٤٦,٦١ % ، بينما تراوحت نسبة الأحماض الدهنية عديدة عدم التشبع بين ١٩,٩٩ % إلى ٤٤,٦٢ % .

و كنتيجة لهذه الدراسة ، فإن جميع النتائج التي تم مناقشتها تناხض فى أن جميع عينات اللحم المفروم تحت الدراسة تتوافق كيميائياً مع للمواصفات القياسية المصرية ٢٠٠٥ م ولكن فقط العينة M_2 كانت آمنة من وجہة النظر الميكروبيولوجية. كما يمكن اعتبار عينات اللحم المفروم المستهلكة في مدينة المنصورة غذاءً آمناً لتجذبة الإنسان ، ولكن هناك حاجة لتحسين شروط التخزين والتداول لهذه العينات للحد من التلوث الميكروبيولوجي ونمو الاحياء الدقيقة.

الكلمات الرئيسية : اللحم المفروم ، الخصائص الكيميائية ، مشتقات البروتين ، ثوابت الدهن ، والأحماض الدهنية والتحاليل الميكروبيولوجية.

قام بتحكيم البحث

أ.د./ عبد الحميد إبراهيم عبد الجاد

كلية الزراعة - جامعة المنصورة.

كلية الزراعة - جامعة كفر الشيخ.

أ.د./ كمال متولي أحمد النمر