

CHEMICAL AND MICROBIOLOGICAL CHARACTERISTICS OF SOME MINCED MEAT SAMPLES CONSUMED IN EL-MANSOURA CITY

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ABSTRACT

This present manuscript was carried out to be ensure that if these collected minced meat samples consumed here in El-Mansoura city were compatible with minced meat Egyptian Standard Specification or not. And also, try to establish that these samples were safe and in high quality for human nutrition. So, three minced meat products were collected from El-Mansoura city (five replicates). Every product represented meat products company.

From all discussed results fat content of minced meat samples scored values which ranged from 17.48 to 21.94% and these results in agreement with *Giese, (1992)* while the highest protein content (22.19 %) was recorded for M₁ sample as reported by *Sadler and swan, (1991)*. 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 21.09% to 26.48% and as percentage of total nitrogen. Furthermore, non protein nitrogen (NPN) of minced meat samples ranged from 0.1% to 4.40% of total nitrogen and 22.1% to 28.1% of total soluble nitrogen. At last, free amino nitrogen (FAN) values varies from 11.63% and 14.33% of total nitrogen.

The highest acid value (AV) in minced meat samples was 0.03 for M₁. As for oxidative rancidity, peroxide values (PV) of minced meat samples ranged between 19.33 to 29.69 for M₁ and M₂, respectively. Saturated fatty acids in minced meat fat ranged from 0.3% to 0.30% 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 40.2 % to 46.61%, while polyunsaturated fatty acids percentage ranged between 1.99 % and 4.62%.

In conclusion, the present study has clearly indicated that from all discussed results, all collected minced meat samples were chemically in accordance with Egyptian standard specifications for year 2000 but only M₁ sample was safe from microbiological view.

Minced meat consumed in El-Mansoura city could be considered as a safe food for human nutrition, but there is a need for good handling and storage condition to reduce microbiological contamination and growth.

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 developed countries. Their consumption is affected by various factors. The most important ones are product characteristics such as sensory, nutritional properties, safety, price, and convenience. The consumer and environment-related ones like psychological, health, family or educational aspects, general economic situation, climate, and legislation, etc. These factors are usually closely linked to social, economic, political and geographical aspects. The

consequence of all these is that in rich societies one of the aspects that most affects the “image” and hence the consumption of meat is whether it is perceived as healthy (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.

Egyptian Organization of Standardizations EOS,(2000) for frozen meat restricted the moisture content of minced meat to 70% or less, protein content should not be less than 14% and fat content has to be 20% or less. TBA number should not exceed 0.9 mg malonaldehyde/kg meat. As for microbiological aspects, the same author stated that clostridium count in minced meat should not exceed 10^7 cfu/g, total bacterial count of minced meat should not exceed 10^7 cfu/g. On the other hand, they stated that staphylococcus should be less than 10^7 cfu/g and shouldn't have salmonella and shigella.

Ouf (2004) studied forty frozen camel meat products samples (10 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%, respectively. *Shigella sp.* failed to be detected in all examined camel meat products.

USDA, (2010) stated that 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. As oleic acid, it was 50.52% and linoleic acid was 10.38%.

MATERIALS AND METHODS

Materials:

Mansoura City was divided into three different sites. From each site three main companies were chosen. Three samples of minced meat were collected from each chosen company.

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

Methods:

All samples were maintained at 4°C into ice box, then the three minced meat samples collected from the three chosen companies were mixed and homogenized to obtain a comprehensive sample for each company product.

All aforementioned prepared samples were packaged into polyethylene bags and stored at -18°C up to chemical analysis. This treatment was carried out to avoid moisture loss, chemical changes. And for microbiological examinations, three samples of each product were microbiologically analyzed and then mean were taken.

Chemical analysis:

Moisture, total nitrogen, crude fat, ash and salt contents were determined using AOAC, (2002) methods.

Carbohydrates content was calculated by difference.

Energy value: It was calculated as follows:

Energy value = carbohydrates % $\times 4$ + protein % $\times 4$ + fat % $\times 9$

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

If $X < 0.1775$, $a_w = 1.014 - 0.639X$.

If $X > 0.1775$, $a_w = 1.0288 - 0.714X$.

Where: $X = \text{NaCl \%} / \text{Moisture \%}$.

Total volatile nitrogen (TVN) was determined according to the method mentioned by Pearson (1974). 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, 1977).

Free amino nitrogen (FAN) was determined as explained in the (AOAC, 2002).

Fat was extracted from the meat products samples by grinding using an electrical blender and then soaking them in Hexan 60-80 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 -20°C until analysis.

IV test was carried out as described by AOAC, (2002) by using Hanns solution and it was expressed as g I/100 g fat.

PV for all extracted fat from minced meat samples was determined according to the method described in AOAC, (2002). The PV was expressed as milliequivalent peroxide/kg fat.

AV for extracted fat from minced meat samples was carried out according to the method of AOAC, (2002) and was expressed as ml KOH/gm fat.

Free fatty acids content (FFAs %) was calculated from a formation determined using in (AV) and applying the following equation, according to AOAC, (2002):

$$\text{FFA\%} = \text{acid value} \times 0.03$$

The FFAs reported as percent free fatty acids expressed as oleic acid.

Thiobarbituric acid value (TBA) was determined as described by Tarladgis et al., (1970) TBA value was expressed as mg malonaldehyde/Kg fat with the following equation:

$$\text{TBA} = \nu, \lambda \times \text{O.D}$$

O.D = Optical Density at 630 nm (absorbency).

The methyl esters of extracted fat were prepared according to the method described by (AOAC, 2000).

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

HP 6890 GC capillary.

Temperature programming:

Initial: 100°C

$100-170^\circ \text{C}$ at $10^\circ \text{C} / \text{min}$ then,

$170 - 192^\circ \text{C}$ at $0^\circ \text{C} / \text{min}$, holding five min then,

$192 - 220^\circ \text{C}$ during 10 min , holding 5 min .

Column:

DB – 22 capillary columns.

$60 \text{ m} \times 0.25 \text{ mm} \times 0.25 \text{ m}$.

Gases:

H_2 flow rate 40 ml/min

N_2 3 ml/min

Air 40 ml/min .

Injector temp. 230°C

Detector temp. 200°C .

pH value was measured according to the method of Lima Dos Santos *et al.*, (1991) using pH meter (Hanna instruments pH 213 Microprocessor pH meter) apparatus.

Microbiological evaluation:

Minced meat products sample bags were opened aseptically and 10 gm of sample were taken and completely minced in porcelain dish, then transferred to 90 ml of sterile water. The suspension was shaken 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 37°C for 24 hours before counting Gilliland *et al.*, (1977). The average of triplicate readings was taken.

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 10 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, 2007).

For detecting and enumerating *Staphylococci*, appropriate dilutions of meat samples were carried out and then planted with Staphylococcus medium No.110 (Difco, 1994).

Total salmonella and shigella colonies were counted following the method of (Miyamoto *et al.*, 1991)

Dilution frequency determinations is a technique was adopted to determine the densities of anaerobic spore forming clostridia , using selective liquid media, ° 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*, (1909) medium. After the incubation period the most probable number was obtained by the use of *Hoskin's*, (1932) Tables and related to dry weight.

RESULTS AND DISCUSSION

Approximately chemical composition of collected minced meat samples were shown in Table (1). Moisture values ranged from 67.02% to 73.08% in all minced meat samples, as for fat content M₁ sample scored the least value which represented 17.48%, while M_r and M_r samples were 21.94% and 19.94%, respectively. The first sample was not in compatible with EOS, (2000) while the other samples were in agreement with (EOS, 2000) 20%.

The highest protein content 22.19 % was observed for M_r. The protein content of all minced meat samples was in accordance with EOS, (2000) 18% which mentioned that the protein content must not be less than 18%.

Generally, the high of moisture content in minced meat samples, the low of protein and fat contents were occurred. Therefore, the highest moisture content (M₁) showed the lowest energy value (232 k cal./100 g).

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

Samples	Moisture%	Ash %		Crude Protein%		Crude Fat %		Carbohy drates%	Energy value K calorie /100 g
		W.B.	D.B.	W.B.	D.B.	W.B.	D.B.		
M ₁	67,08	0,80	2,33	17,79	18,84	17,48	17,99	0,3	232
M ₂	69,04	0,70	1,71	17,70	18,87	21,94	04,23	0,12	273
M _r	67,02	0,83	1,93	22,19	01,73	19,94	16,39	0,2	273

From the same Table, it could be noticed that, the highest ash content (0,80%) was recorded in M₁ sample, and 0,83% and 0,70% for M_r and M₂ samples respectively.

As for carbohydrate content, it should naturally a small proportion of minced meat composition where, it ranged from 0,12 to 0,3%.

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	1,90	0,9949	6,2	0,76
M ₂	0,42	1,04	0,9976	6,1	0,06
M _r	0,48	1,12	0,9970	0,8	0,70

NaCl%, water activity, pH and acidity% are shown in Table (γ). 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 0.9970 for M₁, M₂ and M₃ samples, respectively.

Furthermore, pH values of different minced meat samples ranged from 6.8 to 7.2. Total acidity percentages as lactic acid were 0.76, 0.86 and 0.60% for M₁, M₂ and M₃ samples, respectively.

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

Although 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 (π): Protein fractions of collected minced meat samples:

Samples	TVN mg N/100g	TSN%	NPN%	FAN%
M ₁	14.77	0.70	0.21	0.41
M ₂	4.06	0.76	0.19	0.40
M ₃	14.91	0.77	0.18	0.41

Table (ι): percentage of protein fraction of collected minced meat samples.

Samples	TN	TVN/TN %	TSN/TN %	NPN/TN %	FAN/TN %	NPN/TSN
M ₁	2.80	0.02	26.48	7.40	14.33	28.1
M ₂	2.84	0.14	26.77	6.09	14.19	24.0
M ₃	3.00	0.42	21.09	0.01	11.63	23.1

Protein fractions of collected minced meat samples and the percentages of these nitrogenous compounds of total nitrogen were tabulated in Table (π and ι).

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 π. These values did not exceed the permissible limit of the **EOS**, (20.0) which reported that, total volatile nitrogen of minced meat must not be more than 20 mg/100 gm. In addition, total soluble nitrogen (TSN) values of minced meat samples were the same as percentages of samples while represented 26.48 and 21.09% as percentage of total nitrogen.

Non protein nitrogen (NPN) of minced meat samples ranged from 0.01% to 7.40% of total nitrogen and 23.1% to 28.1% of total soluble nitrogen. At last, free amino nitrogen (FAN) values varies from 11.63% and 14.33% of total nitrogen.

These previous 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.

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

Samples	Acid value (AV) Mg KOH/g	Free Fatty Acids % As Oleic acid	Peroxide value (PV) "miequivalent O ₂ / Kg fat	Iodine value as gm I/100 gm fat	Thiobarbituric acid (TBA) "mg malonaldehyde / kg sample
M ₁	4,22	2,12	22,34	40,63	0,46
M ₂	3,14	1,08	19,33	44,44	0,31
M ₃	0,03	2,78	29,69	29,96	0,22

Data given in Table (2) show minced meat fat indices. The higher acid values (AV) in minced meat samples was 0,03 for M₃. Consequently free fatty acids percentage (FFA %) was 2,78% as oleic acid. For the same sample while acid value samples M₁ and M₂ represented 4,22 and 3,14 respectively, while FFA% were 2,12 and 1,08 %, respectively. So, these acid values referred to hydrolytic rancidity caused by lipase enzyme.

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 are not surpassed the admissible limits by EOS, (200) 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.

As Iodine values (IV), it ranged between 29,96 and 44,44 and these results refer to the nature of meat fat which refers, it 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 stability against protein breakdown and fat deterioration.

Table (3): 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	3,10
(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	20,30
C _{20:0}	0,07	0,79	0,72
TSFA	00,13	01,19	01,30
C _{16:1}	2,60	3,28	2,73
C _{17:1}	1,30	1,33	1,39
(oleic) C _{18:1}	41,20	40,86	42,16
C _{20:1}	-	0,44	0,33
MUFA	40,2	40,91	46,61
(linoleic) C _{18:2}	3,94	1,66	1,42
(linolenic) C _{18:3}	0,68	0,39	0,07
PUFA	4,62	2,05	1,49
TUFA	49,82	47,96	48,6
TUFA/TSFA	0,99	0,94	0,90

Data tabulated in Table (٦) showed that the values of saturated fatty acids in minced meat fat ranged from ٥٠,٣% to ٥١,٣٥% from total fatty acids, Taking into consideration predominance both palmitic and stearic acids, which they ranged from ٢٦,٨٧ to ٢٦,٩٦ and ١٧,٨٣ to ٢٠,٣٥% respectively.

The same Table(٦) showed that total unsaturated fatty acids in minced meat samples fat were in between ٤٧,٩٦ % and ٤٩,٨٢%, where monounsaturated fatty acids ranged from ٤٥,٢ % to ٤٦,٦١%, oleic acid was the highest monounsaturated fatty acid (٤٠,٨٦% - ٤٢,١٦%) , while polyunsaturated fatty acids percentage ranged between ١,٩٩ % and ٤,٦٢%, which represented as linoleic acid (١,٤٢ % – ٣,٩٤ %).

The biological value (USFA/SFA) for minced meat samples fat registered ٠,٩٩, ٠,٩٤ and ٠,٩٥ for M_١, M_٢ and M_٣, respectively. Total unsaturated fatty acids percentages were compatible with iodine values. So, all studied samples could be considered a moderate biological value of fat.

Results presented in Table (٧) show microbiological examinations of the studied minced meat samples derived from market. For the M_٢ sample, the total bacterial count (T.C.) using Nutrient Agar (NA) cultivation medium showed to be the highest value being ٥٢٩x١٠^٣ cfu/g of M_٢ sample, followed by M_١ and M_٣ samples represented ٢٩٢ x١٠^٣ and ٢١x١٠^٣ cfu/g, respectively.

The same results showed that, in case of *Salmonella* and *shigella* values, M_١ showed to be the most contaminated one being ٠,٠١٤ x ١٠^٣ cfu/g followed by M_٢ sample of being ٠,٠٠٢ x ١٠^٣ cfu/g while M_٣ sample was free from *salmonella* and *shigella* bacteria. In addition, in case of *staphylococcus* all samples were free. The *E.coli* test showed the highest value in M_٣ sample as ٠,٠٣٢ x ١٠^٣ cfu/g while other samples were free.

Table (٧): Microbiological examination of collected minced meat samples:

Samples	Microbiological test (CFU/g) sample				
	T.C.	S.S.	Staph.	E.Coli	Clost.
M _١	٢٩٢ x ١٠ ^٣	٠,٠١٤ x ١٠ ^٣	-	-	٧,٦ x ١٠ ^٣
M _٢	٢١ x ١٠ ^٣	٠,٠٠٢ x ١٠ ^٣	-	-	١,٩ x ١٠ ^٣
M _٣	٥٢٩ x ١٠ ^٣	-	-	٠,٠٣٢ x ١٠ ^٣	٩,٧ x ١٠ ^٣
EOS	١٠ ^٣	free	١٠ ^٣	No limit	١٠ ^٣

From the same results in Table (٧) the clostridium test showed to be the slightly high in all minced meat samples, where it was ١,٩ x ١٠^٣ cfu/g in M_٢ sample and this value was within the permissible limit (١٠^٣). But, M_١ and M_٣ samples contained higher number of spore forming bacteria, reached ٧,٦ x ١٠^٣ and ٩,٧ x ١٠^٣ cfu/g, respectively.

From all discussed results, it could be summarized that all collected minced meat samples were chemically in accordance with EOS, (٢٠٠٥) but only M_٢ sample was safe from microbiological view.

Conclusion

In conclusion, the present study has clearly indicated that from all discussed results, it could be summarized that all collected minced meat samples were chemically in accordance with EOS, (٢٠٠٥) but only M_٢ sample

was safe from microbiological view. Minced meat consumed in El-Mansoura city could be considered as a safe food for human nutrition, but there is a need for handling and storage condition improvement to reduce microbiological contamination and growth.

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الخصائص الكيماوية و الميكروبيولوجية لبعض عينات اللحم المفروم المستهلكة في مدينة المنصورة

أبو بكر محمد حسن ، شادي محمد الشهاوي و محمد ممدوح محمد ربيع
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تم اجراء هذه الدراسة بغرض التأكد من توافق عينات اللحوم المفرومة المتداولة والمستهلكة في مدينة المنصورة مع المواصفات القياسية المصرية ام لا. وكذلك في محاولة للتحقق من أن هذه العينات امنة و ذات جودة عالية لتغذية الانسان. لذلك تم تجميع ثلاثة منتجات من اللحم المفروم من مدينة المنصورة (خمسة مكررات) . كل منتج يمثل شركة منتجة للحم المفروم.

ومن مناقشة النتائج امكن تقرير أن محتوى الدهون في العينة M1 سجل أقل قيمة وهو ما يمثل 17,48 ٪ ، في حين تم تسجيل أعلى نسبة البروتين (22,19 ٪) للعينة M3. أما بالنسبة للنيتروجين الكلي المتطاير للثلاثة عينات من اللحم المفروم فلم يتجاوز قيمة 20 ملجم / 100 جرام . وبالإضافة إلى ذلك ، يتراوح النيتروجين الكلي الذائب لعينات اللحم المفروم من 21,09 الى 26,48 ٪ كنسبة مئوية من مجموع النيتروجين الكلي . وعلاوة على ذلك تراوحت قيم النيتروجين الغير برويتيني في عينات اللحم المفروم من 5,01 ٪ إلى 7,45 ٪ من النيتروجين الكلي و 23,1 ٪ إلى 28,1 ٪ من النيتروجين الكلي الذائب

بالنسبة للنيتروجين الأميني الحر تراوحت القيم من 11,63 ٪ إلى 14,33 ٪ من إجمالي النيتروجين. وكانت أعلى قيمة لرقم الحامض في عينات اللحم المفروم 5,03 للعينة M3 . أما بالنسبة للترنخ التأكسدي ، تراوحت قيم رقم البيروكسيد في عينات اللحم المفروم بين 19,33 - 29,69 للعينات M2 و M3 ، على التوالي . تراوحت الأحماض الدهنية المشبعة في دهن اللحم المفروم بين 50,3 ٪ إلى 51,35 ٪ من مجموع الأحماض الدهنية ، في حين أن مجموع الأحماض الدهنية غير المشبعة في عينات دهن اللحم المفروم تراوحت بين 47,96 ٪ و 49,82 ٪ ، حيث تراوحت الأحماض الدهنية احادية عدم التشبع بين 45,2 ٪ إلى 46,61 ٪ ، بينما تراوحت نسبة الأحماض الدهنية عديدة عدم التشبع بين 1,99 ٪ و 4,62 ٪

و كنتيجة لهذه الدراسة ، فإن جميع النتائج التي تم مناقشتها تتلخص في أن جميع عينات اللحم المفروم تحت الدراسة تتوافق كيميائياً مع للمواصفات القياسية المصرية 2005 . ولكن فقط عينة M2 كانت آمنة من التلوث الميكروبيولوجي . كما يمكن اعتبار عينات اللحم المفروم المستهلكة في مدينة المنصورة غذاءاً آمناً لتغذية الإنسان ، ولكن هناك حاجة لتحسين شروط التخزين والتداول لهذه العينات للحد من التلوث الميكروبيولوجي ونمو الاحياء الدقيقة.

الكلمات الرئيسية : اللحم المفروم ، الخصائص الكيماوية، مشتقات البروتين ، ثوابت الدهن ، والأحماض الدهنية والتحليل الميكروبيولوجية.

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