Chemical and Histological Quality of Oriental Sausage Produced at Lower Commercial Grades

Nancy Samir M.Rabii, Ali Meawad Ahmed, Makram Ahmed M. Yassien

Dept. of Food Hygiene, Faculty ofVet. Med., Suez Canal University

Abstract

Fresh sausage is one of the most popular further processed meat products. It is formulated from a combination of raw ingredients which yield a final product of acceptable quality and competitive price. Moreover, the high chemical and histological quality is necessary to improve the processed the final products. Therefore, The sums of 100 samples of fresh sausage (class II & class III) were collected from different localities of Ismailia governorate and evaluated for histological and proximate analysis.All sausage samples contain skeletal muscles less than that recommended by Egyptian Slandered, however all of the examined samples were contain excess of adipose tissue, non-skeletal tissues and gristly tissues. The mean of moisture, protein, fat and ash content of the lower grade sausage (III) was 52.12, 4.59, 35.01 and 6.21 respectively. The mean of moisture, protein, fat and ash content of the high gradesausage (II) was 60.07, 14.72, 28.61 and 4.37 respectively. The obtained results were compared to Egyptian Standard and suggestions were given to improve the chemical and histological quality of the oriental sausage traded at Ismailia markets.

1- Introduction

Long time processing of meat to a limited number of traditional products had been practiced by butchers in their shops according to old standing local customs. In fact it was a mean for marketing the inferior quality meat cuts or trimming. In last nears decades the processing of beef have an accelerated extension, among these products is the oriental sausage that compromise a major sector of the output of meat processing plants. After the seventies by low enforcement imported deep frozen meat became the basic raw materials for processing of such products.

Sausage is a comminuted product composed of meat or edible meat byproducts that are seasoned with condimental substances which may contain certain additives in permitted amounts. It is marketed fresh, cooked, smoked, semidry or dry. Different compounds are added to sausages as preservatives, curing agents, flavor enhances, color fixatives, or expenders. A precise formulation must be adopted to ensure that the final products fulfill the standard regulations.

Sausage production varies according to the size of the operation and equipment of the plant in addition to the type produced. Batching is the initial step in the production where all of the ingredients are set out in the correct proportion before processing. Next the meat chopped to the desired size. All the ingredients make up the final product are mixed.

Chemical analysis require to reveal that additives approved by the Egyptian standards (1972/2005) sets limit regarding the amount of an additive. Theses additives must meet a specific justifiable need in the product and must not be used to deceive consumers with

regard to freshness, quality or weight. The Egyptian standards require that ingredients be truthfully and properly listed on the product labels.

The present study was planned to evaluate the chemical and histological quality of different grades of beef oriental sausages collected from Ismailia city markets considering the Egyptianstandardization.

2- Materials and Methods

2.1. Samples: The sums of 100 samples of raw traditional Egyptian meat product, the fresh sausage were collected from different localities of Ismailia governorate.Each of class II & class III were represented by 50 samples, the samples were purchased from local butcher's shop; the producers of the fresh oriental sausages which representative field samples; the samples shall be about 500gm from each store.Representative individual's field samples were transferred to sterile container with sterile instrument and under aseptic condition, the temperature of the samples was noticed and recorded at the time of sampling, all samples container had to be marked immediately after the samples is taken, samples transported in an insulated container with sufficient refrigeration to maintain the temperature at $5^{O}C$ until arrival at laboratory.

2.2. Histological examination: The tested sample was represented by duplicate tiny cube 1x1cm, each cube wrapped tightly with guaze fasten with thread, forming blocks.

2.3. Qualitative Histometric examination: One of the prepared sections was used for image analysis to quantify the amount of individual animal tissue content. Different tissues were detected and scored with automated and manual colour threshold image analysis by use of an Olympus Bx43 light microscopic and image analysis programme.Olympus Stream essential version 1.9.1 (Olympus) for each Calleja-stained sections of sausages samples three area of 3.62 mm^2 were examined and the percentage area density for each were quantitatively determined.

2.4. Proximate Chemical Analysis (AOAC, 2010):

The casing of each fresh sample was removed where the sample rendered into uniform mass by passing through meat mincer to be mixed thoroughly; these operations were carried rapidly with great caution to avoid any drop in moisture or any other chemical changes; the used mincer was thoroughly cleaned, rinsed and dried before.

2.5. Determination of moisture content: Accurately 5 grams of the prepared sample was weighed into a previously prepared porcelain dish with known weight. Spread the samples over the bottom of the dish to cover the greatest area, was dried at $100^{O}C$-$102^{O}C$ in a thermostatically controlled hot air oven for 16 – 18 hour. Dried sample was cooled in desiccator then weighed accurately, the process of heating and desiccation was repeated until two successive constant weights were obtained.

2.6. Determination of protein content: One gram of prepared samples was accurately weighed out on folded filter paper. That filter paper and contents transferred to a kjeldal flask with 8 gram catalysis mixture. With care 25 milliliter's concentration sulphoric acid were

added on the sample which left for few minutes. The flask with its content being warm slowly and carefully to minimize initial frothing, then heat increased up to boil until the solution clears, vigorous boiling continue for a further hour with the flask attached to the venting tube to remove acid vaporous. The digestion flask removed from the digester, carefully cooled (the distillate must be kept cool throughout the distillation) the digested mixture transferred to another flask of 500 ml. volume, that new flask contained the digested mixture with 75 milliliter's of sodium hydroxide 40% connected up to the distillation unit. Steam distillation starts a receiving titration flask containing 50 milliliters of pure grade boric acid 4% was placed on the distillation unit to receive, the distillate ie: the liberated ammonia. At ceasing of distillation the flask was removed and few drops of screened methyl red added, titrated against 0.1MIsulphoric acid, the equivalent amount the has been used in neutralizing the expelled ammonia, taken in consideration that 1 cm^3 0.05M Nlsulphoric acid equivalent to 0.0014g. nitrogen. The crude protein content can be determined by multiplying the nitrogen value by 6.25 as a factor of protein in general.

2.7. Determination of ether extrabold fat: Accurately 3 grams of the prepared sample were weighted into thimble contained treated sand, mixed thoroughly with glass rode before butting the thimble into oven at $125^{O}C$ for about one hour. The thimble removed from the oven, cooled and transferred to extraction unit. Soxhlet flask of known weight was connected to the unit of extraction; then the previously treated dry mixture was extracted with petroleum ether. The temperature of the extraction unit was adjusted to ensure condensation rate of 5 drops/ second, that step processed for about 6 hours, by complete of the extraction process petroleum ether evaporated in boiling water bath the flask was dried in oven at $100^{O}C$ for 30 minute, cooled in desiccator and weighted.

2.8. Determination of Ash: Ten grams of prepared sample were weight into porcelain crucible previously prepared and weighted.The sample was heated at $100^{O}C$ to get rid of moisture the placed in muffle furnace thermostatically controlled, the temperature adjusted at $550^{O}C$where the sample hold for 8 hour with graduated increase of the temperature until the white ash was obtained which indicate that the free from carbonaceous matter.The crucible was carefully transferred to desiccator cooled and weighted according to the rules.

3- Results and Discussion

The manufacture of sausages to the small trader is an operation specifically designed for utilizing goints unsold after a day's trending and it's for this reason, that the shelf-lift of this particular type of production may be relatively short. This practice must be strictly controlled by legislations which allow continual checkup on.

3.1. Histological Quality: The aim of histological investigation is to identify offending components to elucidate information about kind of tissues used in accordance with the Egyptian standards of quality control. Moreover, difficulties in identifying non-skeletal ingredients are faced during processing since the processing steps often change the morphological pattern of tissues.

The histological evaluation of the cured sausage samples revealed that skeletal muscles, adipose,connective (collagene and elastine) tissues, blood vessels, nerves and glandular tissues were found.

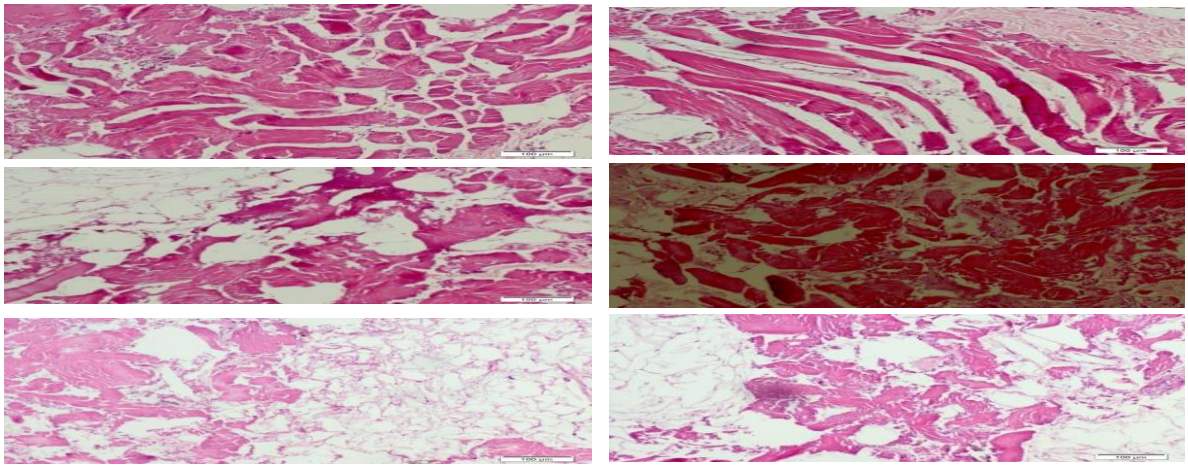


Image (A1-6) for ordinary sausage samples: High amount of skeletal muscle & low amount of fat and C.t.

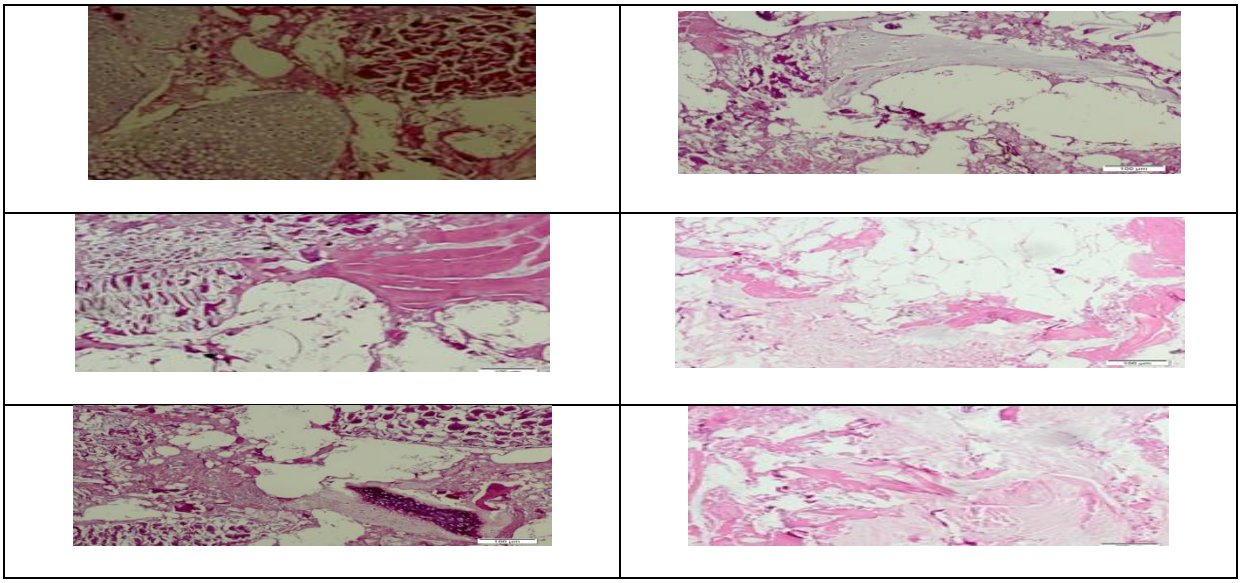
The kind and quality of the ingredients used in the manufactured of sausages are governed by several factors, such as consumer demands, trading competition, economic ground the concept by which the producer may choose to allocate special cuts and parts of a carcase considering the final coast.

On comparing stromal proteins with that of myofibtillar proteins, it was known that the biological quality than that of the muscular tissues, it's of low nutritional value as it lack some of the essential amino acid and less accepted, there may be a wide differences in the relative amount of connective tissue used for skeletal muscles, moreover, trimmings edible offal, tendons, skin, even inedible offal though it is known scientifically that the protein content of beef is higher than the protein of the internal organs so additional of internal organs to the manufactured products will lower their nutritional quality and cold be detected histologically.

Comparing the obtained results (image 1 and 2) with that recommendation by the Egyptian organization for standardization and quality control (ES:1972 / 2005) it was recorded that the samples contain skeletal muscles less than that recommended, however all of the examined samples were contain excess of adipose tissue, non-skeletal tissues and gristly tissues.

Histological examination may control the falsification, but the interpretation vary according to the food habits and manufacturing practice. It provide useful data on the nature, quality and substances added more than other of histological examination.

Substituting primal-mat cuts by cheaper one was a subject that researchers gave it great attention; processing especially mincing expected to obscure the structure changing the texture, appearance, colour and consequently may affect flavor.



Image(b1-b6) for Popular sausage samples:High amount of Cartilage & Fat and low or amount of skeletal meat.

The analytical methods may be chemical, biochemical or include microscopicalyexamination which recommended with histochemical analysis as more applicable in identifying tissue types.

It was stated that the adulteration of the superior quality meat by inferior one is common practice globally known. Knowing the histological structure besides the nature of the other ingredients is important for the possible economic loss by fraudulence also to ensure that the processors readily acting with accordance with standards **(Mingual*et al*., 2004; Ayaz*et al*., 2006 and Yosef*et al*., 2012).**

3.2. Proximate Chemical Analysis

It should be well known that the chemical composition and the minute structure of lean, fat and connective tissue is very important in the study of meat for a clear understanding of the effect on meat – products and consequently upon the eating qualities of the product which the consumers looks for muscle tissues contains several types of proteins with many different functions.

3.2.1. Moisture: In meat products water serves as a carrier for salts and other ingredients permitting uniform distribution throughout the product; During chopping, which inevitably produce use of flaked ice or chilled water, the chopping should be done speedily so that the temperature of sausages mat does not rise above $7.2^{O}C$. In most products the ratio of moisture may attained to four times as protein. A regulated amount of water – specific for each product – has been added to enhance the tenderness, juiciness and palatability taken in consideration that the moisture level is affected by air flow, humidity and temperature of the storage area; when the correct combination of these is employed the surface remain moist enough to prevent shrinkage and discoloration.

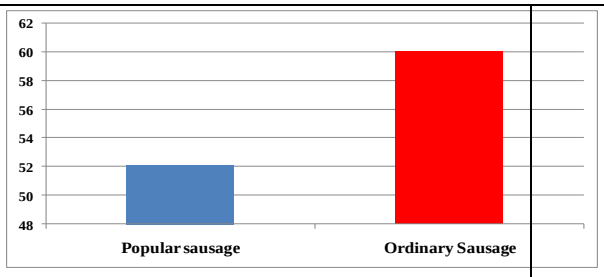


Figure (1): Moisture content of different kind of sausage

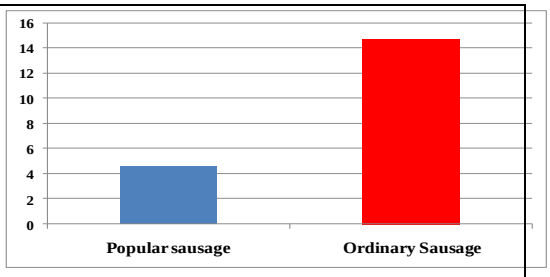


Figure (2): Protein content of different kind of sausage

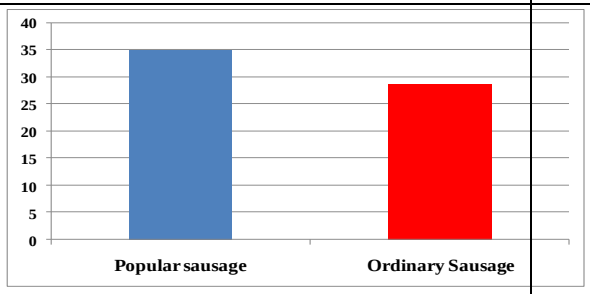


Figure (3): Fat content of different kind of sausage

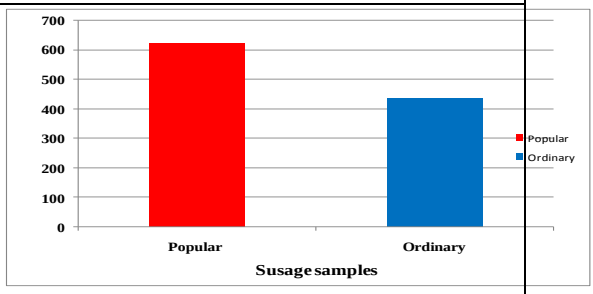


Figure (4): Ash content of different kind of sausage

Figure (1) shows that the mean of moisture content of the tested samples of the lower grade (III) was such percent was scarcely raised up for grade (II) to be. These records were not in accordance with that specified by ES, 1972/2005 which stated exact percentage around 60%. It is worthy to state that overall samples of the surveillance contained higher of the moisture than the right percentage recorded by the Egyptian standards (Table 1). Basically when a lable of meat- product reads "water added" that mean a regulated amount of water has been added to enhance its overall specification; but when the tested samples of both grades recorded moisture around 97% that considered falsification, hazardous random steps of manufacturing. There is a specific level of moisture in such raw fresh oriental sausage samples to satisfy requirements for both of mould& bacteria to thrive.

Table (1): Moisture results of sausages compared to Egyptian standard

Samples	Popular sausage	Ordinary Sausage
Within the EOS	38 (%)	49 (%)
Out of EOS	12 (%)	1 (%)

EOS (2005): moisture of sausage is 60%

Grinding, chopping, salting, application of chemicals or organic additives, freezing, thawing and heating are treatments that can affect the final water content of meat-products consequently texture, colour&flavor; such facts were discussed by several authorswhome recorded either low or high level of moisture content in fresh raw sausages (**Romans *et al.*, 2001; Cornejo and Chinachoti, 2003; Honikel, 2004; Huff-Longergan and Longergan, 2005; Heinz *et al.*, 2007 and Luiet *al* 2010Hafez *et al.*, 2014)**recorded moisture content of 67 $\pm$ 0.20%.

3.2.2.Protein Content:Meat protein are ground in three general item, myofibrilla, stromal and sarcoplasmic. Each class differ according to the functional properties it contributes to meat. Myofibillar protein is that comprise the muscle fibers, including actin and myosin the most important componants among others collectively called myofibillar proteins. Action and myosin are the most abundant proteins directly involved in the ability of muscle to contract & relax; this extremely important as it relates to muscle tenderness. Stromal proteins are collagen, elastion and reticulin fibers from their the connective tissue composed.

The sarcoplasmic proteins include hemoglobin and myoglobin pigments beside the wide variety of enzymes which occur naturally in muscle tissues and continue to function during the aging of meat among those enzymes the proteolytic one that degrade the protein when it break down myofibrillar type, thereby contributing to the tenderness.

The results recorded in figure (2) shows that the mean of protein percentage of grade III was 4.59 $\pm$ 0.10 meanwhile that of grade II was raised to be 14.72 $\pm$ 0.22 to fulfill relatively level of (15%) that recommended by the Egyptian standards (ES: 1972 / 2005) (Table 2).

Table (2): Protein results of sausages compared to Egyptian standard

Samples	Popular sausage	Ordinary Sausage
Within the EOS	34(68%)	48(96%)
Out of EOS	16 (32%)	2 (4%)

EOS (2005): Protein of sausage is 15%

The results pointed to the extreme differences of the protein percentage of the sausage samples from grade III that not in accordance with legal specification, beside that though fresh sausage samples of grade II showed percentage scarcely lower than the recommended level, it had significantly higher protein than grade III ($P < 0.05$).

Meat product quality based on the desired characteristics of the raw meat, at the same time there are main determines of quality at consumer level such as flavor intensity, juiciness & tenderness. Quality can also be estimated more objectively through properties of the ground meat used and its level in the products. It was known scientifically that the protein content of the internal organs is lower than the protein of the beef so addition of the internal organs to the manufactured product will lower their protein contents, moreover its nutritional quality **(Priolo*et al*.,2001 and Weglar, 2010).**

Basically, there is a need to know the source of the tissues in meat – products to estimate the quality of certain animal tissues and identify the raw materials involved; this particularly true for comminuted meat products. This consideration is important where governmental regulations mention exactly the quality standards which establish the kind of tissue to be used in processing.

The Egyptian standard stipulate that fresh sausage should not contain the non-skeletal tissue, but difficulties in identifying that non- skeletal components are encountered with

thoroughly comminuting tissues during processing especially if treated with high temperature during cooking. More advanced technique may be required to interpret the low protein percentage of the samples of grade III.

3.2.3. Fat: Fats are important components as it add flavor, appetite appeal and satiating value to the products, it has a significant effect on eating quality attributes of beef specially juiciness and tenderness. Consumers are not only care about health conscious of high fats content but also about the ratio of saturated and unsaturated fatty acid moreover omeg-6 and omeg-3 where he prefer lean meat and search for products with less fat, some have an idea about the essential fatty acids and the fat soluble vitamins **(Resurreccion, 2003 and Wood *et al.*, 2004)**. The fat content of most processed meat-products is government regulated. The fat content of most sausages limited by the Egyptian organization for standardization to a maximum of 30 percent.

Figure (3) revealed the extreme increase in the fat percentage attained to 54.75± 2.12 for grade III, such mean recorded very highly significant difference at ($P < 0.001$) than that recorded by the samples of grade II where the fat percentage was 32.59 ± 3.82. **El-Gharably&Ashoush (2011)** wrote about higher percentage of fat; 40% beef fat related to beef meat in the formulation of sausages with traditional formula.

Table (3): Fat content of sausages in relation to the Egyptianstandard

Samples	Popular sausage	Ordinary Sausage
Within the EOS	32(64%)	49(98%)
Out of EOS	18 (36%)	1 (2%)

EOS (2005): Fat of sausage is 30%

Meanwhile lower figures were recorded by **Abd El-Aziz (2004)** that wrote fat percentage ranged between 16% - 19% with a mean value of 17.5% in the samples of the minced meat which constitutes the major ingredients of sausage. Also **El-Nashi*et al.*, (2015)** in an independed replicate trials recorded mean of fat percentage with minimum of 16.23 ± 0.31 and maximum of 17.63 ± 0.36%.

Fats found in varying qualities in meat-products, though it does not support the bacterial growth it likely results in off-flavour and rancedodour during the abuse storage rendering the product unfit.

Marbling is an important factor in judging and grading beef, the amount and distribution of visible fat in lean meat is a major criterion must be considered. Intramuscular fat & marbling fat melts during cooking there by increasing the juiciness and perceived tenderness. However as stated earlier – added water can be substituted for fat. Sausages with a lable stating "Lower fat" must have 25% less fat than 30% fat in the usual sausage products of that less type, ie less than 22.5% total fat.

3.2.4. Ash: Mineral components in raw meat are Na, K, Ca, Mg, Fe, and P. **(McCance and Widdowson, 1960 cited after Lawrie, 1975)**.The results recorded in figure (2) shows that

the mean of protein percentage of grade III was 6.21 ±2.23 meanwhile that of grade II was 4.37 ±0.59.

Table (4) Ash results of sausages compared to Egyptian standard

Samples	Popular sausage	Ordinary Sausage
Within the EOS	50(100%)	49(98%)
Out of EOS	0(0%)	1 (2%)

EOS (2005): Ash of sausage is 5%

Of these phosphorus is quantitatively the most important, followed by potassium except in cured meat where sodium from the added salt predominates. In respect of however, meat is an important source of iron, but the concentration of iron in liver is markedly higher. It would appear that mutton contains more calcium than beef. Differences between muscles of food animals are found, those in sodium, potassium even myoglobin among, the soluble non-nitrogenous substances are the inorganic total soluble phosphorus, potassium sodium, magnesium, calcium and zinc beside trace metals common – salt can be determined on ash, moreover by determining the calcium in the ash it is possible to get some idea to whether the sample contained milk or not, the ash may also be checked for the presence of added phosphate **(Lawrie, 1975)**. All of the previously stated points may declair the beneficial role of ash determination.

Total ash is the inorganic residue remaining after the organic matter has been burnt away. The ash figure can be regarded as a general measure of quality, the ash obtained is not necessary to be exactly the same as the minerals of the original food as there may be losses due to vitalization, or interaction between constituents **(Egan *et al.*, 1981)**.

The presence of the undesirable tract elements may be due to natural occurrence or due to the improper use of impure ingredients for the manufacture of the product moreover the dissolution of metals from processing equipment or containers such as the low-graded tinplate, foils, galvanized iron or cheap enamels or glazes, dry ashing is a convenient methods with precaution must be taken.

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الجودة الهستولوجية والكيميائية للسجق الشرقي المنتج في درجات تجارية متندية

نانسي سمير ربيع ، علي معوض أحمد ، مكرم احمد محمد يس
قسم الرقابه الصحيه علي الاغذيه ، كلية الطب البيطري ، جامعة قناة السويس

الملخص العربي

يعد السجق الطازج احد أكثر منتجات اللحوم المصنعة شعبية حيث يصنع من مزيج من المكونات اساسها اللحوم والتي تنتج منتج نهائي ذو جودة مقبولة وأسعار تنافسية .وللوصول لذلك فيجب ان تتميز مكوناته الاساسية الداخلة في التصنيع علي جودة كيميائية وهستولوجية عالية. لذلك كلن الغرض من هذه الدراسة هو تقييم الجودة الهستولوجية والكيمائية لعدد 100 عينه من السجق الشرقي من فئات تجارية مختلفة والمتداول بمناطق مختلفه بمدينة الاسماعيبليه. و تبين من الفحص ان جميع عينات السجق تحتوي علي انسجه عضليه اقل من تلك التي اوصت بها المواصفات القياسيه المصريه في هذا الشأن بالاضافه ان احتوت جميع العينات تحت الدراسة علي كميه كبيره من الانسجه الدهنيه والانسجه الغير هيكليه. وكان قيمة متوسط محتوي الرطوبه والبروتين والدهون والرماد في السجق الشعبي المعروف المصنف درجة ثالثة هو 52.12 و 4.59 و 35.01 و6.21 علي التوالي بينما كان قيمة متوسط محتوي الرطوبه والبروتين والدهون والرماد في السجق المصنف عالي الجودة هو 60.07 و14.72 و28.61 و4.37 علي التوالي. و قد تمت مقارنه النتائج المتحصل عليها مع المواصفات القياسيه المصريه ومن ثم تقديم اقتراحات لتحسين الجوده الكيميائيه والهستولوجية للسجق الشرقي المتداول في الاسواق التجاريه بمدينه الاسماعيليه.