QUALITY EVALUATION OF SOME PROCESSED RAW MEAT PRODUCTS: *MERGUEZ*

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ABSTRACT:

Merguez is a spicy fresh sausage prepared with uncooked lamb, beef or a mixture of both meats, from Berber North African cuisine that is popular in Algeria. In order to assess the morphological quality of Merguez and influence of $a_w$and pH on the hygienic quality of this sausage, ten samples from raw meat product (Merguez) were subjected to physicochemical and histological analyses. From a physicochemical point of view, the majority of the samples have a water content of 66.85 ± 2.17%. Meat products that have a_w of 0, 94± 0, 02, have pH of 6, 32± 0, 14.The histological evaluation provides the percentage of meat content (defined as the skeletal muscle content) with 2.53 ± 0.5% and the percentage of connective tissue with 1.80 ± 0.73%.The quality of this meat product is closely related to the ratio of skeletal muscle and connective tissuewith a value of 5.53%.A variety of other tissue types were variably identified in the sampled meat product, including, blood vessels, bone, cartilage, peripheral nerve, adipose tissue, and parasite such as sarcocystis.The histological study of meat products is not currently used in Algeria in the field of food safety and control. It could be an interesting contribution, in addition to physicochemical and bacteriological studies, for accurate identification of tissues used in food products.

Keywords: *Merguez*, histology evaluation, pH, a_w

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INTRODUCTION

The production of various sausages is of great importance to the meat industry of North Africa. *Merguez* is a typical Algerian raw sausage; it is regarded as food of choice because of their nutritive values (Hamiroune et *al*., 2017; Cixous et *al*., 2017). Its high contents in proteins and the nature of those made these products as essential food for a balanced feed ration which is manufactured from a mixture of chopped meat (lamb or beef), salt, additives, and spices (characteristically ground black pepper) and it is usually prepared by butchers to be sold within two days because of like all fresh products, it deteriorates quickly in particular under bad conditions of storage (El Ayachiet *al*., 2007).This shelf life depends on the presence of some physical-chemical factors such as relatively low water activity (a_w) and low pH value (Hamiroune et *al*., 2017; Cixous et *al*.,2017).

Moreover, because of the economic value of meat, use of unauthorized animal tissue is possible in meat products. Some researchers have reported histological methods as an effective technique to detect and estimate the percentage of meat and unauthorized tissues in some meat products (Prayson et *al*., 2008a; Prayson et *al*., 2008b; Latorre et *al*., 2015; Sadeghinezhad et *al*., 2015), to Detect meat structure (Sharedeh et *al*., 2015; Astruc et *al*., 2008) and to distinguish between fresh and thawed meat (Qi et *al*., 2012; Sikes et *al*., 2017).

Based on these observations, the aim of the current study was to evaluate *Merguez* quality in processed meat products which used physical-chemical and histological methods.

MATERIAL AND METHODS

Ten samples of raw sausage (*Merguez*) were randomly collected from supermarkets from Batna city (Algeria). The samples were placed in an ice tank to be gone through histological and physical-chemical examination.

Physical-chemical analysis

The water composition of the various *Merguez* was evaluated by desiccation, after fresh weighing and then dehydration in an oven at 37°C for three days according to (Avinee et al., 2010). Water activity (a_w) was estimated by Hygroscope BT-RS1 Rotronic. Sample mass was cut to small pieces (2-5 mm) and put into a sample cup. The cup was filled to the upper edge. The probe was immediately put into the sample cup. The result was read as soon as the humidity and temperature values became stable according to Hristo et *al*., 2013. The pH was measured by Professional pH Meter INOLAB according to (Hristo et *al*., 2013), from a mixture resulting from the grinding of 10 g of *Merguez* in 90 ml of distilled water.

Histological analysis

To determine the tissue composition, 5 to 10 tissue blocks were randomly selected from each *Merguez*, which were fixed in 10% buffered formaldehyde for at least 24 hours. The sample was treated usually and included in paraffin. From each of the defined blocks, sections of 4 microns thick were obtained in a microtome.

Specimens were taken from sausage and immediately fixed in 10% buffered formaldehyde for 24 hours. The fixed materials were dehydrated in an ascending series of ethanol, cleared in xylene and then embedded in paraffin wax. Five paraffin blocks from each sample were obtained. Serial sections at 5–7 µm were cut using a Jung-histocut, 820Leica, microtome, Germany and mounted on glass slides.

From selected *Merguez* samples, four sections for each block were stained with hematoxylin and eosin (Luna 1960), 15 sections by special histochemical staining (five sections with Lugol-Calleja (Hildebrandt and Hirst, 1985), five sections with PAS-Calleja (Hildebrandt et Hirst, 1985) and five sections with Alizarin S (Luna, 1960).

RESULTS AND DISCUSSION

The different physicochemical parameters are indicated in the Table 1.

The different *Merguez* samples were mainly composed of water, the water content is 66.85g/100g of product. Lower values were reported for *Merguez* in France (Avinee et *al*., 2010).According to (JORADP, 2000), meat products must not contain more than 60% water.

The high water content in the present study may also include other liquids that are part of the emulsifying agents used in the manufacture of meat products (Prayson et *al*., 2008a). A water activity is the availability of water for microbial, enzymatic and chemical reactions that determines the stability of meat products (Fellows, 2000).

The results of our study reveal that the water activity of our samples have values ≤ 0.94, while the pH values have an average of 6.32. These conditions can also promote the multiplication of pathogenic micro-organisms.

Table1. Data of Physicochemical values of *Merguez*

Measured water Content (%)	pH	Aw	Muscle tissue *(M)	Connective* tissue* (C)	C / M
66,85 ± 2,17	6,32± 0,14	0,94± 0,02	2,53±0,5	1,80 ±0,73	5,53

***Percentage area density of skeletal muscles, and connective tissues of five different quality of *Merguez* based on analysis of four digitised images of each histological section**

Histological evaluation in this study indicates that this meat product contains several types of tissue. This diversity of the types of tissues observed is not completely different from what was found in the analysis of meat products in the United States (Prayson et *al*., 2008a; Prayson et *al*., 2008b). The impression that meat is the main component of meat products seems misleading because of the relatively low percentage of skeletal muscle mass in this study (Table 1); most of the tissues identified in this study are associated with skeletal muscle, connective tissue (Fig. 1.A), adipose tissue (Fig. 1.B), blood vessels (Fig. 1.C), and peripheral nerve (Fig. 1.D).

Calleja staining has been selected because of its relevance to meat products (Sifre et *al*., 2009). The histochemical staining also makes it possible to detect the collagen fibers; the proportion of connective tissue in the *Merguez* samples is 1.80%. The quality of these meat products is closely related to the ratio of skeletal muscle and connective tissue. Our results show that this ratio is 5.53%.A fragment of cartilage (Fig. 2. E) and bone (Fig. 2. F) tissues were observed in some samples of *Merguez* resulting meat hash process.

Based on morphological criteria for observing histological sections using an optical microscope, we have identified parasite type *Sarcosystis* in samples of *Merguez.*

In optical microscopy, the thickness of the wall is a good criterion for determining the species involved: the first type is thin-walled, characteristic of *Sarcocystis cruzi* (Fig. 2.G) while the second is thick-walled; it could be to act either *Sarcocystis hominis* or *Sarcocystis hirsuta* (Fig. 2.H).

The identification of other ingredients used in the production of meat products is also important for the evaluation of the quality of the final product (Pospiech et *al*., 2009). The Lugol Calleja histochemical method was selected for the preliminary analysis of starches in meat products. This method was selected because of the binding of Lugol solution iodine to the starch polym We have detected the starch which is not declared in the composition of *Merguez* (Fig. 3. I).

Among other histochemical techniques, PAS-Calleja staining can also be used to detect starches. However, in the case of starch detection in meat products, PAS-Calleja staining also reacts with other polysaccharides, which cannot be considered a relevant method for starches exclusively (Fig. 3.J).

CONCLUSION

The *Merguez*, despite the transformation processes, retain their structures and are easily identifiable due to the use of adequate histological stains. In Algeria, these techniques are still far from being applied and require the placing of regulations that ensure the implementation of these techniques and reveal certain fraudulent practices and show the hidden side of meat products.

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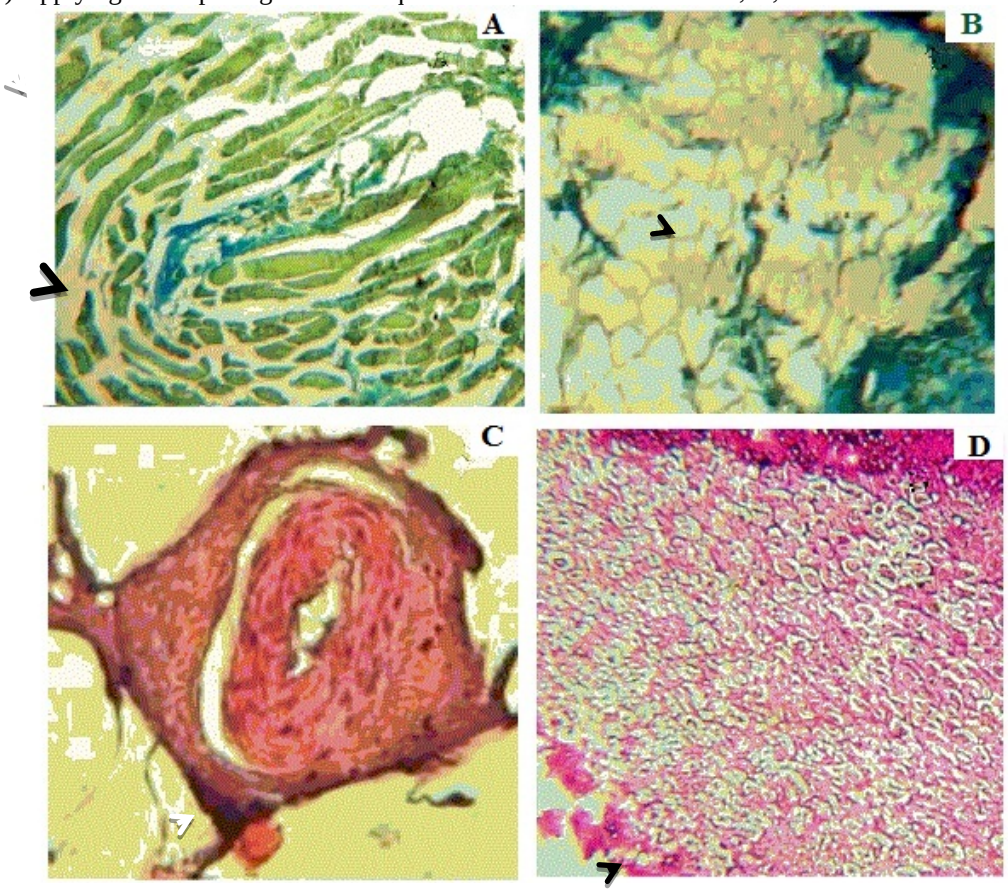

Figure 1: Authorized tissues

(A)*Merguez* with striated muscular tissue (White arrow) and connective tissue (black arrow),
(B) adipose tissue (black arrow) (PAS -Calleja,×100).
(C) blood vessels (White arrow) ,
(D) Peripheral nerve *tissue* (black arrow) (hematoxylin eosine, ×100).

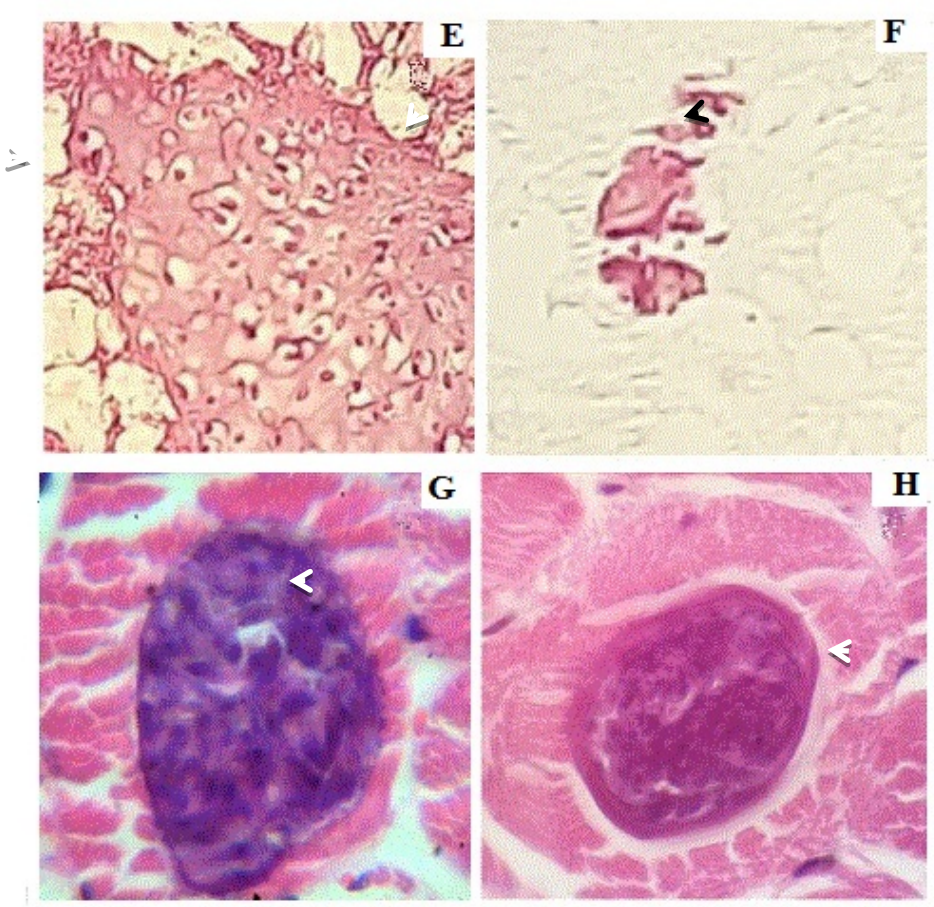

Figure 2: Unauthorized tissues

(E) Cortical bone (black arrow) (red Alizarin S×100)
(F) Cartilaginous tissue (White arrow) (hematoxylin eosine ×100)
(G)*Sarcocystis* with a thin-walled (White arrow) (hematoxylin eosine ×1000)
(H)*Sarcocystis* with a thick-walled (White arrow) (hematoxylin eosine ×1000)

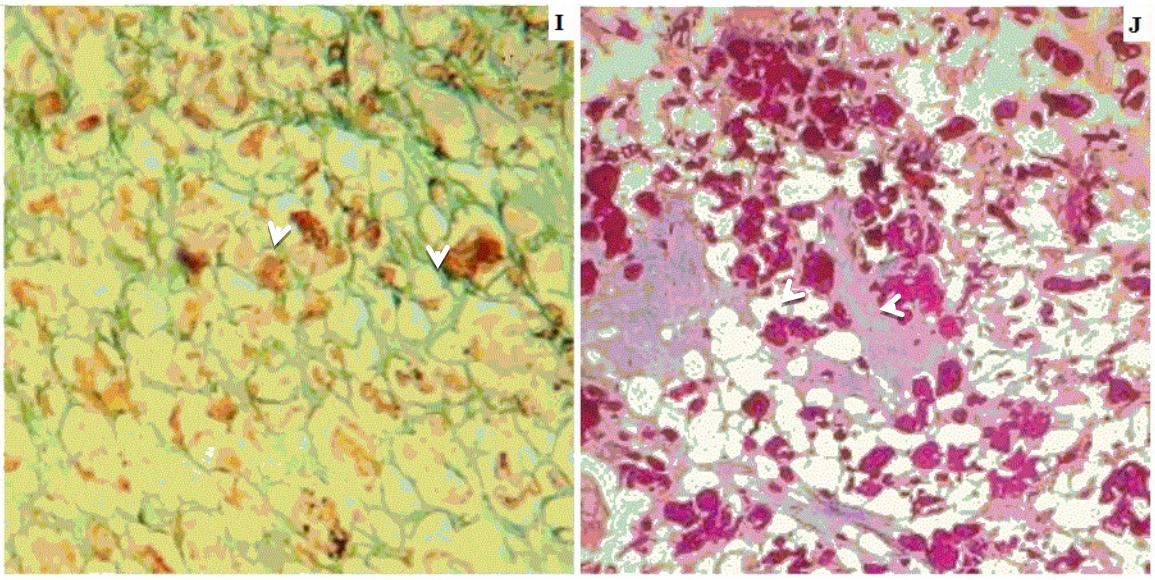

Figure 3: vegetal tissues

(I)starch (White arrow),(Lugol Calleja ×100)
(J) Polysaccharide(White arrow),(PAS-Calleja×100)