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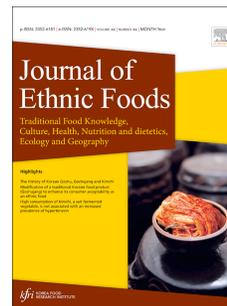
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## Ethnic meat products of the North-African and Mediterranean countries: an overview

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**Running title:** Traditional meat products in North Africa

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### Abstract

Traditional meat products constitute one of the ancient cultural heritage of the North-African and Mediterranean countries: Egypt, Libya, Tunisia, Algeria and Morocco. Over years, peoples of these countries consumed numerous meat products in such a way that biochemical and microbial action can take place to help increase the shelf life but also to enhance the flavor and nutritional quality of the products. These ethnic meat products are prepared using different animal sources, but all verified to be *halal*, and consumed during local events, family celebrations or religious feasts. In this systematic review, 32 most known traditional meat products [*Melfouf*, *Merguez*, *Kofta*, *Guedid*, *Cured Guedid*, *El messli*, *Kourdass*, *Tidkit*, *Soudjouk/Sucuk/Nakanek*, *Boubnita*, *Pastirma*, *Fregate*, *Merdouma/Mandi/Bourdim*, *Tafra-gara*, *Maynama*, *Khliia Ezir*, *Laknaf*, *Osmana*, *Bnadek*, *Khlii*, *Kobiba*, *Mcharmila*, *Boubnita/Member*, *Mkila*, *Tehal/Tehane*, *Ban-Chems*, *Bouzoulouf/Zelif*, *Klaya*, *Douara/Bekbouka/T'qalia*, *Tangia*, *Mrouzia* and *Cachir*] from the 5 countries were documented. The main objectives of this overview were to report the traditional knowledge that covers the origin, preparation, characteristics, and consumption habits of the 32 North-African traditional meat products. Moreover, the listed meat products were grouped into 5 categories using both traditional and scientific knowledge related to their preparation. The identified categories are i) salted and/or marinated meat products but not dried (category I); ii) dried not fermented meat products (category II); iii) fermented semi-dry/dried meat products (category III); iv) smoked meat products (category IV) and v) cooked and/or candied meat products (category V). The common eating practices of these products and the related historical and socio-cultural aspects were discussed.

**Keywords:** Traditional meat products; North Africa; Ethnic preparation diagrams; Maghreb; Cultural practices; Algeria

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**Running title:** Traditional meat products in North Africa

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Traditional meat products constitute one of the ancient cultural heritage of the North-African and Mediterranean countries: Egypt, Libya, Tunisia, Algeria and Morocco. Over years, peoples of these countries consumed numerous meat products in such a way that biochemical and microbial action can take place to help increase the shelf life but also to enhance the flavor and nutritional quality of the products. These ethnic meat products are prepared using different animal sources, but all verified to be *halal*, and consumed during local events, family celebrations or religious feasts. In this systematic review, 32 most known traditional meat products [*Melfouf*, *Merguez*, *Kofta*, *Guedid*, *Cured Guedid*, *El messli*, *Kourdass*, *Tidkit*, *Soudjouk/Sucuk/Nakanek*, *Boubnita*, *Pastirma*, *Fregate*, *Merdouma/Mandi/Bourdim*, *Tafra-gara*, *Maynama*, *Khliia Ezir*, *Laknaf*, *Osmana*, *Bnadek*, *Khlii*, *Kobiba*, *Mcharmila*, *Boubnita/Member*, *Mkila*, *Tehal/Tehane*, *Ban-Chems*, *Bouzelouf/Zelif*, *Klaya*, *Douara/Bekbouka/T'qalia*, *Tangia*, *Mrouzia* and *Cachir*] from the 5 countries were documented. The main objectives of this overview were to report the traditional knowledge that covers the origin, preparation, characteristics, and consumption habits of the 32 North-African traditional meat products. Moreover, the listed meat products were grouped into 5 categories using both traditional and scientific knowledge related to their preparation. The identified categories are i) salted and/or marinated meat products but not dried (category I); ii) dried not fermented meat products (category II); iii) fermented semi-dry/dried meat products (category III); iv) smoked meat products (category IV) and v) cooked and/or candied meat products (category V). The common eating practices of these products and the related historical and socio-cultural aspects were discussed.

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## 77 1. Introduction

78 Ethnic meat products are traditionally, culturally and commercially most the valuable food  
79 products in different countries throughout the world [1-5]. They constitute important elements of  
80 gastronomic and nutritional heritage of many countries, which are consumed for centuries [6]. In  
81 Africa, namely in the North and Mediterranean countries, dozens traditional meat products exist.  
82 However, only few of them were scientifically reported [7-11]) and characterized [8-10, 12-18].  
83 On another hand, the regional cultural differences vary greatly within the Mediterranean and  
84 African peoples, giving rise to different styles of food across Morocco, Algeria, Tunisia, Libya  
85 and Egypt countries that are collectively known as *Maghrib* (“the West” in Arabic) compared to  
86 the Middle Eastern part of the Arab world, called *Mashriq* (“the East”). The meat products  
87 prepared by the North-African peoples are usually dried or cooked, due to the climate, and are  
88 rarely smoked. They have a variety of diameters, shapes, sizes, spices, seasonings, and sensory  
89 characteristics. Their names differ also according to the geographic origin, sometimes even  
90 between very close areas of the same country. Consequently, the information in the scientific  
91 literature related to the meat products of these countries is very scarce and refers only to recipes  
92 described in few brief culinary books.

93 In recent years, traditional food products including meat-based ones have been increasingly  
94 regaining consumer interest worldwide [15, 16, 19-23]. This would be due to their particular  
95 sensory properties, high quality and natural composition [21, 24, 25]. The consumers trust also  
96 that they have potential health characteristics [26, 27]. Furthermore, the particularity of ethnic  
97 meat products is their close connection to the culture, heritage and the local identity of the  
98 concerned countries. Consequently, they would have a strong symbolic value by contributing to  
99 the sustainability and development of rural areas. From these viewpoints, this systematic review  
100 grouped the main and popular traditional meat products of the North-African countries and  
101 overviewed the preparation diagrams of 32 ethnic meat products as well as their related cultural  
102 eating aspects. Thus, the intention of this overview is to describe for the first time the most  
103 popular traditionally prepared meat products of the North-African countries, their distribution  
104 and consumption during local events, family celebrations or religious feasts.

## 105 2. Culinary traditions of the North-African and Mediterranean countries: a brief history

106 The dietary culture and culinary style of the north westernmost part of Africa along the  
107 Mediterranean Sea, known as the North-African countries, consisting of Egypt, Libya, Tunisia  
108 Algeria and Morocco, is the result of a set of historical, cultural and geographical factors. All  
109 these countries are by origin Berber. However, the old trade routes, links with Europe and

110 Asia, and the Mediterranean climate have all influenced the improvement of preparation and  
111 consumption of muscle-based foods in Morocco, Algeria and Tunisia in the west (the *Maghreb*  
112 or *Maghrib*) to Libya and Egypt in the east (the *Mashrek* or *Mashrik*) [28, 29]. Egypt occupies  
113 an ambiguous position: while it has cultural, ethnic and linguistic ties to both the *Mashriq* and  
114 the *Maghreb*, it is different from both and is usually seen as being part of neither; however,  
115 when it is grouped with one or the other, it is generally considered part of the *Mashriq* due to  
116 its closer ties to the Levant. Similarly, Libya may itself be seen as bifurcated between *Mashriq*  
117 and *Maghrib* influences, with its eastern part seen as linked more to Egypt and the *Mashriq*.

118 The historical and archaeological Remains showed that the earliest humans at the beginning  
119 of their existence in North Africa survived by hunting and mountain foraging. Therefore, meat  
120 animals, intestine and blood were probably the primary source of food for these people [29].  
121 For many years, several ethnic practices were used in North-African countries mainly to  
122 preserve the excess of meat into more stable products that could be consumed when food or  
123 meat sources are scarce; using primitive processes such as curing, smoking, sun-drying or  
124 fermentation. Because the North-African countries are predominantly Muslim, “*halal*” meats  
125 are usually eaten and that is what is reported in the actual recipes. In all North-African and  
126 Mediterranean countries, *halal* meat is available for purchase everywhere. *Halal* is an Arabic  
127 word that means “permissible” [30, 31]. As reported by these last authors, permissible meat in  
128 the Islamic tradition comes from animals that have been treated kindly, and killed in a way that  
129 minimizes the animal’s suffering. The words of the *Basmala* “*In the name of God, most*  
130 *beneficent, most merciful*” must be uttered at the time of animal slaughtering. All blood must  
131 be drained from the animal, and it must be cleansed before being eaten. Thus, pork and any  
132 food products derived from pork are forbidden from the diet and traditional meat products in  
133 accordance with the Islamic dietary laws.

134 Various civilizations invaded North-African countries namely Phoenicians (332 B.C),  
135 Romans (30 B.C), Arabs (642 A.D), Spanish, Turks (16<sup>th</sup> century), Italians, and finally the  
136 French and British (18<sup>th</sup> and 19<sup>th</sup> century), which all influenced the eating practices of these  
137 countries and contributed to the diversify meat-based foods [32]. However, The North-African  
138 areas were under ottoman control for a long time (14<sup>th</sup> - 18<sup>th</sup> century). Therefore, there were  
139 more significant influences of Turkish culture than others [33].

### 140 **3. Socio-cultural, religious and hygienic aspects of preparation and consumption of meat** 141 **products in North-Africa countries**

142 Initially, farming was the main activity of the North-African people where meat was the  
143 main food product in the region, consumed in an indigenous way together with wheat. The  
144 domestic livestock in this area is mostly beef, sheep, goats, camel and poultry [33]. The lamb  
145 and mutton consumption is particularly privileged in the North-African countries, namely  
146 during the religious feasts. However, as stated above and owing to religious considerations,  
147 pork consumption is prohibited [34]. For milk, cattle is the most and principal source but goat  
148 milk is also highly consumed. Usually, beef is eaten only when the animal becomes older and  
149 of no economic use. Whereas, lamb is slaughtered on special occasions. For example, during  
150 the religious feast of the sacrifice "*Aid Al Adha*", weddings, birth of a child and circumcisions  
151 [33]. The feast of "*Aid Al Adha*", also known as the great (*el-Kebir*), takes place on the 10<sup>th</sup> day  
152 of the month of *Dhu 'l-Hijja*, the day that the pilgrims to Mecca sacrifice a sheep. Muslims  
153 around the world are expected to do the same if they can afford to and to distribute part of the  
154 meat to those who cannot do it. As a result, the foods of "*Aid Al Adha*" tend to involve meat.  
155 Thus, all parts of the animal are valorized (meat, offal, fat, head and legs) to prepare meat  
156 products or dishes with typical characteristics using ancestral practices that correspond to each  
157 ethnic people [35].

158 The North-African peoples consider meat products as nutrient-rich products that ensure  
159 health and wellness. Also, for the people of these countries serving meat to guests is a sign of  
160 respect and a way to honor them. The traditional meat preparation involve natural and oldest  
161 techniques such as curing, drying, fermentation, cooking and sometimes smoking, which are  
162 all used not only to increase the shelf-life but also to enhance the flavor and nutritional quality  
163 of the products [9, 10, 36-38].

164 Different meat products are prepared using one or mix of techniques, and there exist meat  
165 products, which are usually dried (*e.g. Guedid*), smoked (*e.g. Fregate*), fermented (*e.g.*  
166 *Pastirma*), roasted on a charcoal (*e.g Melfouf*), cooked (*e.g. Tangia*) and some of them are fried  
167 (*Mkila*). As well, the intestines are used to prepare sausages (*e.g. Sudjouk*) or sausage-like  
168 products (*e.g. Kourdass*) [7, 39]. The preparation of most of North-African meat products had  
169 their own typical organoleptic characteristics, which are mainly attributed to the spices and  
170 herbs added during seasoning [7]. The use of spices plays an antimicrobial activity and  
171 improve the microbiological quality of final meat products [10, 40].

#### 172 **4. Popular traditional meat products of North-African and Mediterranean countries:** 173 **classification according to the indigenous knowledge of preparation**

174 This systematic review was conducted in two phases. Initially, a field survey was conducted  
175 in different areas of the North-African countries. The information were sought directly from local  
176 household on traditional knowledge of preparation of ethnic meat products. The questionnaires  
177 were sometimes conducted to collect maximum of the traditional meat products and the  
178 corresponding preparation diagrams. The survey has targeted mostly the aged persons and in  
179 some cases, only women's are considered. This was however judged reasonable since the native  
180 skills of food preparation is mainly passed in the North-African countries from mothers to  
181 daughters. However, the respondents were, when possible and namely for Algerian peoples, face-  
182 to-face interviewed using a written semi-structured questionnaire consisting of simple open-  
183 ended questions. The survey questions focused mainly on traditional knowledge of preparation,  
184 mode of consumption, meat source, sociocultural practice, and the ethnic value. We tried to  
185 select the informants based on their knowledge in the indigenous North-African culture and  
186 heritage. The second phase of the preparation of this overview was based on scientific and  
187 literature knowledge. Thus, all the previously published studies in the field were used including  
188 the North-African and Maghreb culinary books. Thus, 32 most common ethnic meat products of  
189 the North-African and Mediterranean countries were identified and listed in the **Table 1**. The 32  
190 meat products were then grouped into different sub-families before projection in a geographical  
191 map (**Fig. 1**) by their corresponding number as in **Table 1**.

192 For several reasons, it is extremely difficult to classify ethnic meat products due to the use of  
193 several preparation steps including more than one transformation technique. The available  
194 literature indicated that there is no common classification system to categorize meat products into  
195 distinct sub-families [41]. Therefore, we tried to list all the information available for the 32 meat  
196 products concerning the animal species, preparation steps, method of preservation, use of spices  
197 and ingredients and even the final product characteristics and uses. Thus, the 32 listed ethnic  
198 meat products considered the above characteristics and were grouped into 5 categories based on  
199 the preparation and preservation techniques steps (**Table 1**). The distinguished 5 categories were  
200 **i) salted and/or marinated meat products but not dried** (Category I); **ii) dried not fermented meat**  
201 **products** (Category II); **iii) fermented semi-dry/dried meat products** (Category III); **iv) smoked**  
202 **meat products** (Category IV) and **v) cooked and/or candied meat products** (Category V). Before  
203 the presentation of the ethnic meat products of each category, a brief overview is given based on  
204 the literature. After what, the corresponding meat products were then presented and once possible  
205 photograph of their final aspects (ready-to-eat) are depicted.

#### 206 **4.1. Salted and/or marinated meat products but not dried (Category I)**

207 Since ancient times, meat and salt have been the only two strictly necessary ingredients in  
208 the preparation of several meat products. Typically, salt, namely NaCl is historically the first  
209 ingredient used for the preservation of fresh meat into cured meats [42-45]. For example, it was  
210 used by the Egyptians c. 2000 BC as a rock salt, sea salt or mined salt [46]. Salt plays a number  
211 of effects on meat products, most of them desirable, as it provides a salty taste and flavor  
212 perception, it allows the control of microbial growth, it modifies the water activity and hence  
213 controlling microbial spoilage and it enhances the occurrence of oxidative processes of the  
214 muscle food [47]. NaCl is generally added during the mixing phase, while for the whole meat  
215 pieces, it can be added by means of dry or wet salting. On another hand, the cured meats are  
216 the meat products that have been treated with NaCl and nitrate or nitrite. Broad ranges of other  
217 ingredients, most of them from plants, are also used.

218 The addition of spices and herbs to traditional cured meat products, as for salt, improve the  
219 sensory and textural properties and contribute to the enhancement of the microbiological safety  
220 of the final products [8, 48-50]. Among these we can find for the North-African countries:  
221 coriander, curcuma, garlic, cardamom, celery seeds, cinnamon, cumin, ginger, saffron, paprika,  
222 and pepper (black, white or red), that have been the most frequently employed as *Sharmula*  
223 (spicy preparation) for marinated meat products [7, 9]. *Sharmula* is added to the meat as a dry  
224 powder or dissolved in water to form a curing marinade. The use of spices is very frequent in  
225 the case of traditional meat products. The addition of spices not only contributes to color and  
226 flavor development, but also provides a source of external contamination, an antioxidant effect,  
227 and in some cases an inhibition of microbial growth [51, 52].

228 Salted and/or marinated meat products can be prepared from whole tissue of meat or from a  
229 piece of meat cut into small cubes such as *Melfouf* or ground coarsely as *Merguez* and *Kufta*.  
230 Further preparation steps such as cooking or smoking [41] can also be salted or marinated. The  
231 final products are generally ready-to-eat meats, which are consumed within 2 days after  
232 preparation [41, 53]. In this first category, three products were listed and are 1) *Melfouf* known  
233 also as *Boulfaf* or *Zenan*, 2) *Merguez* and 3) *Kofta* named also as *Kufta* or *Kabab*.

#### 234 **4.1.1. *Melfouf* /*Boulfaf* / *Zenan* [Product 1]**

235 *Melfouf* is prepared from liver lamb that is slowly roasted under an open hearth (**Table 1**). It  
236 is a very popular meat product prepared in the North West of Algeria and Morocco, namely  
237 during the religious feast of “*Aid Al Adha*”. The traditional preparation diagram and final  
238 aspect of *Melfouf* are given in **Fig. S1A** and **Fig. 2**, respectively. For its preparation and after  
239 removing blood vessels and small skin, the whole liver is grilled for an approximate of two

240 minutes on each side to just cook the surface of the liver and the inside should remain raw.  
241 Then, it is trimmed into small cubic pieces of 2 to 3 cm<sup>3</sup> before salting and seasoning with  
242 spices (salt, pepper and hot red pepper). Subsequently, a lamb caul previously cleaned and  
243 salted wraps each cut liver piece. This allows preserving pieces of liver against drying and  
244 burning. Finally, the chunks skewered onto wooden or iron skewers and roasted with  
245 occasional turning until well done. Some consumers prefer *Melfouf* that is less spiced as they  
246 judge that spices mask the liver taste characteristic. *Melfouf* can be served on bread/wraps with  
247 vegetables and sauces with for example *h'rissa* (a hot sauce originally from Tunisia).

#### 248 4.1.2. *Merguez* [Product 2]

249 The origin of *Merguez* is usually attributed to the Maghreb native people (North-Africa) but  
250 the hometown of this worldwide consumed product remains unknown [54]. *Merguez*, for  
251 which there are several spellings, and all have the same meaning designate a "Sausage". It is  
252 known in Maghrebian Arabic as "*Mergāz*" or "*Merkāza*" and in Spanish Arabic as "*Mirkās*" or  
253 "*Merkās*". The etymology of the word comes from Berber language (*Tamazigh*) designing  
254 "*Amergaz*". The first written recipe for *Merguez* (*Mirqāz*) is in an anonymous thirteenth-  
255 century Hispano-Muslim cookery book. The process of manufacturing *Merguez* is highly  
256 variable from one country to another and even among regions of the same country, depending  
257 on the seasoning, the specific casing used, as well as the way of consumption [55, 56]. It is  
258 generally made of lean and fat lamb, beef and buffalo mixed with condiments (**Table 1** and  
259 **Fig. S1B**). Poultry meat can also be used as recently reported [34]. This sausage normally  
260 contains relatively high amounts of fats (over 20%), with a sodium content around 800 mg/100  
261 g [15]. Briefly, ground meat is mixed with spices and then stuffed into natural casing namely  
262 from lamb intestine (**Fig. S1B** and **Fig. 2**). In Morocco, it is heavily spiced with chilli pepper or  
263 *h'rissa*, conferring its hot and red color characteristic [15]. Further spices such as fennel and  
264 mint would be also included in its preparation. *Merguez* is a fresh raw sausage that has a short  
265 shelf life even when stored at refrigeration temperature, it should therefore, be consumed  
266 within 2 to 3 days after preparation [7, 57]. For its consumption, it is usually grilled or  
267 barbecued, locally known as "*Chwa*" which derives from the word "*Mechoui*" [*Mechoui* is the  
268 traditional North-African roast where a whole lamb is roasted on a spit or in a pit dug into the  
269 ground] to prepare sandwiches. In some countries, likely in Tunisia and Algeria, *Merguez* is  
270 commonly eaten as an ingredient with couscous. *Merguez* is now part of the menu in many  
271 restaurants around the world and is widely consumed in different European and Asiatic  
272 countries.

### 273 4.1.3. *Kofta / Kefta / Kabab* [Product 3]

274 *Kofta* or *Kefta* or *Kabab* is a meat product of oriental origin that has become a fast-food  
275 staple across the world, namely in the North-African countries. It is believed that *Kofta* has  
276 been brought to North-African and Mediterranean countries from Middle East. In fact, the term  
277 “*Kofta*” means “to grind” in Persian. Whereas, it has been suggested that *Kabab* is originally a  
278 Turkish meat product that is brought by Ottoman soldiers who grilled the meat on their sword.  
279 *Kofta* is a ready-to-eat meat product that is prepared from ground meat by charbroiling [34,  
280 56]. The traditional method for *Kofta* preparation is summarized in **Fig. S1C**. Briefly, the  
281 boneless lean meat is minced and mixed with spices, herbs and smashed onions (for the  
282 complete list of condiments see **Table 1**). The blend is usually formed into cigar-shape and left  
283 at least 2 hours before cooking (**Fig. 2**). The pieces of *Kofta* can be roasted directly on glowing  
284 charcoal or molded on a wooden skewer then grilled. In this case, it is called *Sikh Kabab* by  
285 Egyptians [58]. In Algeria, another very similar traditional meat product prepared from beef,  
286 lamb or poultry, namely in Algiers (the capital of Algeria) is used to produce a similar *Kefta*  
287 product that is named *Mthewem*, because it contains high amounts of garlic. However, this is  
288 eaten in a sauce with some boiled Chickpea. Inversely to *Mthewem*, the *Kofta* or *Kebab* is  
289 served immediately with pita bread, *Tahini* sauce or with boiled rice. We can further found  
290 another similar snack or appetizer in Morocco known as *Qotban* (literally, “sticks”) which is  
291 typically made by marinating the meat with vinegar, onions, and pepper.

### 292 4.2. Dried not fermented meat products (Category II)

293 Drying is considered as the oldest method for meat preservation. Originally, it is done for  
294 the single purpose of dehydrating fresh meat for extension of storage, or to preserve meat when  
295 available at quantities exceeding immediate needs [44, 59, 60]. Drying may also be one of  
296 various processing steps during the preparation of specific meat products. Dried meats refer to  
297 a wide variety of products that have been subjected to dehydration, so that moisture content  
298 could be reduced to levels at which the microbial growth is limited [50, 59]. Overall, the  
299 unique sensory quality and microbiological stability of dried meats products are directly related  
300 to several factors including i) the extent of the drying; ii) the achieved moisture and iii) the  
301 method of drying. Dried meats products can be prepared from whole-tissue to fine emulsion of  
302 meat [41]. The popularity of dried meat products in the North-African countries may have  
303 begun as long ago as roman times and it was practiced in the Nile valley for thousands of years  
304 [53]. In this second category, 5 products were listed and are 1) Typical *Guedid* known also as

305 *Kadid* in Maghreb Arabic or *Achedlouh* in Berber (by *Kabylia* peoples in Algeria), 2) *Cured*  
306 *Guedid*, 3) *El M'selli*, 4) *Kourdass* and 5) *Tidkit*.

#### 307 4.2.1. *Guedid/Kadid/Achedlouh and cured Guedid* [Products 4, 5]

308 *Guedid* is a well-known salted and sun-dried traditional meat product prepared in the  
309 Maghreb countries (Morocco, Algeria, and Tunisia) most often after “*Aid Al Adha*”. It can be  
310 prepared from many types of red meats including camel meat and any part of the carcass is  
311 used [11, 12, 17]. The preparation of *Guedid* differs from one region to another and depends  
312 mainly on the ingredients used, the salting and drying techniques (Fig. S2A,B) as well as the  
313 final uses of the product. Thus, the final aspect and color is not always the same (Fig. 3).  
314 Traditionally, the raw meat is cut into thin strips mixed with salt and eventually spices. Salted  
315 strips are then suspended in an open air for sun drying [18, 41]. Salting can be carried out  
316 either dry or in brine, the amount of salt of which is visually appreciated depending to the  
317 quantity of meat used [11]. However, the addition of spices (fresh garlic or powder, hot red  
318 pepper, coriander and mint) is mostly related to the customary use of the area in question [7].  
319 The most reported traditional preparation diagrams are given for *typical Guedid* (Fig. S2A) and  
320 *cured Guedid* (Fig. S2B). Furthermore, the climatic conditions of the preparation area  
321 determine the chemical, microbiological and final sensory aspects and quality of *Guedid*.

322 The water activity of *Guedid* can ranges from 0.50 to 0.7 [17]. The dominant microflora that  
323 ensures the safety of Tunisian *Guedid* was found to be *Staphylococci* [12]. Accordingly, the  
324 isolated strains of *S. xylosus* from Tunisian *Guedid* had good antimicrobial and lipolytic  
325 activities as well as acidifying activities. In addition, the earlier studies reported that *Guedid*  
326 owes its characteristic flavor to lipolysis [17]. *Guedid* is generally stored in plastic bags or  
327 glass jars at room temperature in a dry place to prevent rehydration for several months [61].  
328 For its consumption, it is added to flavor or prepare some traditional dishes such as couscous,  
329 legume stews, *Aiche*, and “*Couscous Avissar*”, a wheat Semolina based dish prepared in  
330 Kabylia region (Algeria) during winter and for the *Berber* new year which is now at 2968  
331 corresponding to 2018.

#### 332 4.2.2. *El M'selli* [Product 6]

333 *El M'selli* is a traditional low moisture meat product found to be prepared in the North West  
334 regions of Algeria. Its traditional preparation process has been reported [11] and summarized in  
335 Fig. S2C. Briefly, boneless lean meat is trimmed into thin pieces or long strips. A mixture of  
336 salt and spices including black pepper, coriander and garlic hot paprika are sprinkled into the

337 cuts and left overnight. The seasoned pieces are then exposed to the sun by hanging on a wire.  
338 After drying, the meat is then incorporated in melted fat and preserved in plastic or glass  
339 containers for several days. *El M'selli* is mainly consumed with stew or sauce.

#### 340 **4.2.3. Kourdass [Product 7]**

341 *Kourdass* is a sausage-like product prepared from offal lamb using stomach, intestines,  
342 liver, lung, spleen and fat (**Fig. S2D**). All the constituents are chopped into small pieces before  
343 salting and seasoning with salt, cumin, hot red pepper, garlic and black pepper (**Table 1**). The  
344 mixture is stuffed into previously washed and cleaned stomach pieces of about 15×10 cm to  
345 form small balls, the rough side of the stomach toward the exterior [7, 39, 56]. After that, each  
346 ball is diametrically rolled up with the intestine to be sealed and sun-dried (**Fig. 3**). The drying  
347 time depends on the size of ball, weather conditions and season. *Kourdass* is eaten after 10 to  
348 15 min boiling. It is either sliced and served with *Couscous*, other traditional dishes or  
349 consumed as a grilled/fried sausage. *Kourdass* is usually prepared for home consumption  
350 during weddings and festivals or during *Moussems*, an annual religious celebration.

#### 351 **4.2.4. Tidkit [Product 8]**

352 *Tidkit* is a sun-dried meat product that is consumed in the southern regions of Morocco.  
353 According to the surveyed persons, it is a mixture of dried meats and chopped fat.  
354 Traditionally, strips or thin pieces of meat are mixed with salt and sun-dried for at least 7 days  
355 depending on the meat thickness and weather conditions. The dried strips called “*Tichtar*” by  
356 Moroccan Berber peoples, are ground to obtain a powder of meat and then mixed with animal  
357 fat and water (**Fig. S2E**). The blend is usually shaped into small balls before cooking for 5 min.  
358 *Tidkit* is a shelf-stable meat product that can be conserved at room temperature. However, the  
359 earlier studies reported that due to the high fat content of *Tidkit*, its stability is affected and lead  
360 to the development of oxidative rancidity [62]. *Tidkit* is similar to *Sharmoot*, a traditional  
361 Sudan meat product [63] and to *Pemmican*, a North-American meat product [64]. However,  
362 *Pemmican* is sold in market as “energy bars” popular around the world [64] while *Tidkit* still a  
363 locally consumed and served at very special events. *Tidkit* is also used to prepare some soups  
364 and sauces.

### 365 **4.3. Fermented semi-dry/dried meat products (Category III)**

366 Fermented meats are meat products that owe, at least partially, their characteristic properties  
367 to the activity of microorganisms [65, 66]. They are subdivided into fermented sausages (made  
368 from comminuted meat) and meat products prepared by salting/curing and dry of the entire

369 muscles or cuts, followed by an ageing period, known as ripening, to achieve the desirable  
370 sensory qualities of the product. Fermented meat products are traditionally and commercially  
371 most the valuable meat products [24, 25, 67, 68]. They can be categorized into several groups  
372 based on various criteria such as the preservation practices of fermentation, the country of  
373 origin or according to the moisture/protein ratio. Furthermore, the classification can be based  
374 on the degree of drying to undried, semi-dry and dry fermented sausages that differ in their  
375 water-activity and final pH [65, 67, 69]. Accordingly, fermented meat products are considered  
376 as “shelf-stable meat” products. The microbiological stability results from a series of specific  
377 factors mainly: i) lowering of pH; ii) high lactic acid bacteria growth rates; iii) decreasing of  
378 water activity; iv) extent of the drying and v) addition of salt and spices [2]. Historically, the  
379 preparation of fermented meat products is often linked to the climatic conditions of production  
380 area [65]. Many types of fermented sausages are produced in the North-African countries that  
381 are usually dried. In this third category, 3 products were listed: 1) *Soudjouk*, known also as  
382 *Sucuk*, or *Nakanek*, 2) *Boubnita* and 3) *Pastirma*.

#### 383 4.3.1. *Soudjouk*, *Sucuk*, *Nakanek* [Product 9]

384 *Soudjouk* or *Sucuk* (Turkey) and related products in the Middle East and Maghreb  
385 (*Nakanek*) is a cured, dry fermented and uncooked sausage of Turkish origin [70, 71]. It is  
386 made entirely from beef or water buffalo, camel and lamb meat (Table 1). It has been produced  
387 and consumed around the Balkans and the Middle East for many years [72]. Traditionally,  
388 *Sucuk* is prepared by mixing ground meat and sheep tail fat (90% lean meat and 10% fat),  
389 sugar, salt, garlic and spices including black or red pepper, paprika and cumin (Fig. S3A). The  
390 *Sucuk* mix is then stuffed into natural casings, often using the small intestine of sheep. After  
391 that, the sausage is hung to ripen and to dry for several weeks at ambient temperature (20 –  
392 25°C) and humidity. Subsequently it is dried to water activity values usually below 0.90 hence  
393 conferring to *Sucuk* its solid aspect (Fig. 4). The fermentation of *Sucuk* can be either made by  
394 microorganisms naturally present or by added starters mostly composed by *Staphylococcus*  
395 *carneus* and *Lactobacillus plantarum* in order to speed up the process and standardize the  
396 quality of the finished product [73]. In *Sucuk*, and irrespective of the preparation process, fat  
397 plays important technological roles during processing. It helps loosen the mixture, which  
398 facilitates continuous moisture release from inner parts of the product. Regular moisture  
399 release from the product is essential for proper fermentation and aromatization of the  
400 fermented product [73, 74]. The final pH and moisture of *Sucuk* are in the ranges of 4.8 – 5.5  
401 and 4.2 – 6.3%, respectively. *Sucuk* is eaten as sliced breakfast ingredient (with eggs or cheese)

402 or included in a sandwich filling. It is further served as an appetizer or used as a topping on  
403 savory pastries and sandwiches [75].

#### 404 4.3.2. *Boubnita* [Product 10]

405 *Boubnita* is a typical Moroccan dry fermented sausage (Table 1), prepared and consumed  
406 mostly after the religious feast "Aid Al Adha". The origin of the word is thought to derive from  
407 Maghreb dialect, "Boubnit" referring to "large intestine of beef/lamb"; where the meat is  
408 stuffed. To prepare *Boubnita*, lamb meat is cut into small cubic pieces, seasoned with spices  
409 (salt coriander, cumin, ginger, red hot pepper, paprika, and olive oil) and stuffed into  
410 previously cleaned lamb intestine (Fig. S3B). The sausage is then tied with a rope and  
411 suspended in the open air where it is left to dry and ferment slowly in the shade (Daoudi et al.,  
412 2006; Benkerroum, 2013). The final product (Fig. 4) is consumed in a sauce with vegetables or  
413 pasta.

#### 414 4.3.3. *Pastirma* [Product 11]

415 *Pastirma* (*Basterma*, *Basturma* or *Pastrami*) is a ready-to-eat meat product commonly  
416 prepared and consumed in Egypt. In fact, *Pastirma* is derived from Turkish "*Basturma*" that  
417 means pressing, as it is the crucial step of its preparation process [72]. The traditional  
418 preparation process of *Pastirma* takes several weeks and includes three well-defined steps (Fig.  
419 S3C): salting, pressing and finally drying and ripening [76-78]. The product is mostly prepared  
420 using whole beef or water buffalo muscles, lamb and camel meat (Table 1) and different parts  
421 of the carcass are used. However, it seems that the quality of the finished product depend on  
422 the muscle cuts used. The traditional diagram and a photograph of *Pastirma* are given in Fig.  
423 S3C and Fig. 4, respectively. Briefly, the meat is trimmed into strips of 60 cm long and 5 cm in  
424 diameter. After that, the meat strips are rubbed and covered with salt, piled up and cured for 2  
425 to 5 days. During this period, the salted meat is sometimes turned or salted again. After what,  
426 the salted meat strips are rinsed with water to remove the excess of salt and air dried for 2 to 3  
427 days during summer and up to 15 days in winter. The dried meat blocks are generally piled up  
428 and pressed with heavy weights then dried. After pressing and drying, the entire surface of the  
429 blocks are covered with a paste consisting of hot pepper, garlic and fenugreek called "*çemen*"  
430 and kept for 1 day. Finally, 5 to 12 days of sun-drying are needed to obtain a ready-to-eat  
431 *Pastirma*. The final pH of *Pastirma* ranges from 5.7 to 6.1 [79]. The microbiological counts  
432 indicated that lactic acid bacteria, *Micrococcus* and *Staphylococcus* were the most abundant  
433 microorganisms in *Pastirma* [80]. The sliced cuts of *Pastirma* are usually consumed with

434 scrambled eggs that are fried, grilled lightly over a charcoal fire [58]. More recently, it is used  
435 as a topping for pizza.

#### 436 **4.4. Smoked meat products (Category IV)**

437 Smoking has been applied for centuries in preservation of meat, by exposing it to smoke,  
438 which is produced by pyrolysis of wood [44]. Smoking is almost an elemental part of curing,  
439 as it is a thermal processing [81, 82]. Smoke curing is a combined treatment, based on the  
440 concerted action of enzymes and heat, which promotes protein and lipid changes in the  
441 previously treated raw material. The treatment has also nutritional implications and affects the  
442 sensory quality, safety, and shelf life of the product due to the bacteriostatic effect of the  
443 compounds present in the smoke. However, the extension of these changes will depend on  
444 many factors, including the type of smoking, the relative humidity, velocity, temperature,  
445 density, and composition of the smoke and the duration of smoking [83, 84].

446 Meat products can be smoked at any point in the preparation process and consequently,  
447 many smoking procedures are used. However, the applied temperatures affect both the typical  
448 sensory properties and the shelf life of the final products [85]. Hot smoking or warm smoking  
449 are carried out at high temperatures and the meat in this case is usually cooked. Contrary to  
450 cold smoking, the meat remains relatively moist with light brown to dark brown color with a  
451 typical smoked flavor [86]. Usually, some of the cold smoked meat products undergo further  
452 treatments before consumption [37]. In this fourth category and among the North-African  
453 traditional meat products, we have listed 4 meat products that are 1) *Fregate*, 2) *Merdouma*  
454 known also as *Bourdim* or *Mandi*, 3) *Tarfa-Gara* and 4) *Maynama*.

##### 455 **4.4.1. Fregate [Product 12]**

456 *Fregate* is a ready-to-eat meat traditional product prepared and highly appreciated by the  
457 indigenous population of southern regions of Algeria called “*Tuareg*” (Table 1). The *Tuareg*  
458 people also spelled *Twareg* or *Touareg* are a large Berber ethnic confederation. They principally  
459 inhabit the Sahara desert, in a vast area stretching from far southwestern Libya to southern  
460 Algeria, Niger, Mali and Burkina Faso. *Fregate* prepared by *Tuareg* consists of cured, smoked  
461 and eventually dried meat pieces mostly prepared from camel meat [11]. The preparation  
462 diagram of *Fregate* has been identified and is given in Fig. S4A. For its preparation, boneless  
463 camel meat is cut into whole pieces of 5 to 6 cm length and 5 cm thick, carefully incised, then  
464 dry seasoned with salt and a set of spices including onion, garlic, coriander and hot red pepper.  
465 The pieces are partially sun-dried and smoked for two to three days. The meat is then buried in

466 a *Matmora*, a hole in the sand that contains ashes for 7 days. *Fregate* can be consumed directly  
467 after smoking or dried again before storage at ambient temperature. In its final aspect, *Fregate*  
468 is eaten with traditional prepared dishes or served with other traditional Saharan foods such as  
469 “*Mella*” bread.

#### 470 4.4.2. *Merdouma* / *Bourdim* / *Mandi* [Product 13]

471 *Merdouma* is one of the most popular ready-to-eat meat products made from a whole  
472 carcass (usually a young and small sized lamb/goat) or whole pieces of beef meat that is  
473 incised, mixed with salt and a set of spices (**Table 1**). It is important to note that the use of  
474 spices is optional. The cuts are cooked in a *Tandoor* (known also as a *Taboon*), which is a  
475 special kind of oven presented as a hole dug in the ground and covered inside by clay. The dry  
476 wood is placed in the *Tandoor* and burned to generate a charcoal. Before closing the hole, the  
477 meat cuts are suspended inside the *Tandoor* without touching the charcoal (**Fig. S4B** and **Fig.**  
478 **5**). The cooking duration depends on the type of meat and the size of the cuts [87]. *Mandi* (in  
479 Egypt) or *Bourdim* (in Libya) is considered as the main dish served during special events, such  
480 as weddings and feasts. It is formerly served with cooked rice or wheat. In Algeria, *Merdouma*  
481 still basically a *Bedouin* practice used after hunting. The term *Bedouin* means a grouping of  
482 nomadic Arab peoples who have historically inhabited the desert regions in North Africa, and  
483 the word comes from the Arabic *badawī*, which means “*desert dweller*”.

#### 484 4.4.3. *Tarfa-Gara* [Product 14]

485 *Tarfa-Gara* is another meat product prepared by the Algerian Saharan peoples. Thus, the  
486 origin of the word is thought to derive from “*Tuareg*” which refers to the stomach of animal.  
487 Indeed, *Tarfa-Gara* is prepared from stomach and offal of lamb or camel (**Table 1**). The  
488 previously cleaned stomach is stuffed by small cubic pieces of offal (intestines, liver, lung,  
489 spleen, and kidney), salted and seasoned (**Fig. S4C**). After that, big stones of approximately 8 cm  
490 and preheated in the charcoal are placed inside the stomach. The smoking/cooking is ensured by  
491 the heat of the stone, stirred occasionally to turn the offal inside stomach and ensure an  
492 homogeneous cooking. *Tarfa-Gara* preparation is a common *Bedouin* practice after hunting.

#### 493 4.4.4. *Maynama* [Product 15]

494 *Maynama* is a traditional Algerian meat product that has become highly popular in the  
495 Southern region of the country. It is a ready-to-eat roasted spicy whole-tissue beef, lamb, goat  
496 or camel meat [88]. The traditional preparation process of *Maynama* (**Fig. S4D**) is similar to  
497 that of *Merdouma*, which consists on trimming, seasoning and smoking. However, the quality

498 of the finished product depends on the meat cuts (amount of lipid content), spices (quantity and  
499 type) and on the type of wood (curing smoke). *Maynama* is now part of the menu in many  
500 restaurants in Southern regions of Algeria. It stills also a common *Bedouin* practice after  
501 hunting (**Fig. 5**).

#### 502 **4.5. Cooked and/or candied meat products (Category V)**

503 Cooking or thermal treatment is an essential step in cooked and/or candied meat products  
504 preparation. Generally, meat is subjected to cooking to enhance its palatability by intensifying  
505 the flavor and to extend its storage life by reducing the incidence of spoilage [89, 90]. The  
506 origin of cooking meat is unclear although it has been existed for millennia when early humans  
507 may first have savored roast meat accidentally, when the flesh of an animal killed in a forest fire  
508 was considered more agreeable and easier to chew and digest than usual raw meat. Dry and wet  
509 (moist) cooking or frying are the most popular thermal processing methods that have  
510 substantial effects on the sensory quality and authenticity of the final products [38]. The dry  
511 procedures refer to a direct exposure of meat to heat including roasting, broiling and grilling.  
512 However, the wet cooking that encompass boiling, stewing and steaming, is a thermal process  
513 that uses a liquid transfer medium [44]. All these cooking techniques contribute to modify the  
514 final texture and aspects of meat and meat products. Cooking contributes further to their  
515 stability by destruction of spoilage and pathogenic organisms [50]. The specific cooking  
516 techniques applied to raw meat are linked to the ethnic background, cultural habits and  
517 tradition of each population and region. Usually, cooked meats are considered as ready-to-eat  
518 meat products [10, 91, 92]. Traditionally, fats and oils are the medium that are often used to  
519 extend the shelf life of cooked meat. They contribute also for certain products to create vacuum  
520 conditions. In this fifth category of North-African traditional meat products, we have listed 17  
521 ethnic meat products that are 1) *Khliia Ezir*, 2) *Laknaf*, 3) *Osbana*, spelled also *Osbane*, 4)  
522 *Bnadek*, 5) *Khlii*, 6) *Kobiba*, 7) *Mcharmila*, known also as *Kemounia*, 8) *Boubnit*, known also  
523 as *Membar*, 9) *Mkila*, 10) *Tehal* or *Tehane*, 11) *Ban-chems*, 12) *Kawareh* or *H'Rgma*, 13)  
524 *Klaya*, 14) *Bekbouka* known also as *T'qalia* or *Douara*, 15) *Tangia*, 16) *Mrouzia* and finally  
525 17) *Cachir*.

##### 526 **4.5.1. Khliia Ezir [Product 16]**

527 *Khliia Ezir* is a typical traditional meat product prepared and consumed exclusively in the  
528 North East of Algeria (**Table 1**). It seems that this meat product originate from Turkey,  
529 probably brought to Algeria between the 15<sup>th</sup> and 16<sup>th</sup> centuries during Ottoman rule in North  
530 Africa. The origin of the word is thought to derive from old Arabic, "*Khliia*" referring to the

531 storage step in olive oil and fat mixture and “*Ezir*” referring to the earthenware jar, the utensil  
532 where it is preserved [10]. *Khliia Ezir* is a cured and cooked meat produced using fresh boneless  
533 (beef, lamb, goat or camel) meat. In the past, *Khliia Ezir* was prepared to conserve meat, when  
534 it is available at excessive quantities especially in the religious feast “*Aid Al Adha*”, but  
535 nowadays it is preferred as a processed meat [11]. Its preparation still a family art involving  
536 different well-defined steps (**Fig. S5A**): trimming, marinating, cooking, ripening and ageing in  
537 an earthenware jar or *Ezir* (**Fig. 6**). The particularity of its traditional diagram process is the  
538 ripening step in *Ezir* for more than 1 year and at room temperature [9, 10]. Thus, *Khliia Ezir* is  
539 prepared according to the traditional diagram given in **Fig. S5A** based on empirical observations  
540 and traditional recipes. Briefly, lean boneless meat (5 – 8 cm length, 4 – 6 cm thick) is cured by  
541 applying a dry mixture of spices including coriander, caraway and fresh smashed garlic. The  
542 amount of salt is ~9% of the total weight. The cured meat is marinated for 7 days, kept at cool  
543 place with occasional stirring before cooking at an average temperature of 80°C on water.  
544 After cooking, the meat blocks are immersed in a mixture of melted bovine fat and olive oil.  
545 The mixt is then preserved in *Ezir* for numerous months at ambient temperature [8-10]. The  
546 average pH of final product is around 6.04 ( $\pm 0.12$ ). Regarding sensorial characteristics, *Khliia*  
547 *Ezir* is judged very tender with high intensity of flavor that is especially attributable to the  
548 presence of garlic flavor. The processing conditions of *Khliia Ezir* indicated that there is  
549 efficient preservation against microorganisms causing microbial spoilage. Several factors  
550 ensure microbial stability of *Khliia Ezir* namely i) dual action of salt and spices, ii)  
551 temperature and time of cooking and iii) the storage in olive oil and fat that create sous-vide  
552 conditions [10]. *Khliia Ezir* is a ready-to-eat meat product, since it is generally consumed  
553 without further processing. It is eaten as an appetizer with bread or added to traditional dishes  
554 such as *Chakhchoukha* and *Aiche*.

#### 555 4.5.2. *Laknaf* [Product 17]

556 *Laknaf* is a typical North Eastern Algerian meat product (**Table 1**), which is prepared using  
557 whole tissue of beef or lamb meat (**Fig. S5B**). Lean boneless meat cuts of 5 – 8 cm length and  
558 4 – 6 cm thick are salted, marinated in a mixture of spices for 2 days before cooking in water  
559 until fibers are easy to separate. The seasoning/marinating spices mixture includes fresh garlic,  
560 coriander and cumin. *Laknaf* is a ready-to-eat meat product that is mainly consumed with *Sfenj*  
561 (a fried donut), or added as an ingredient to various culinary preparations such as lentils and  
562 chickpeas [11].

#### 563 4.5.3. *Osbana/Osbane* [Product 18]

564 *Osmana* spelled also *Osbane* or *Usban* is one of the most popular ready-to-eat meat products  
565 mostly prepared and consumed in weddings and feasts in the North-African countries (**Table**  
566 **1**). It is usually served with couscous or in sauce [93]. *Osmana* is a sausage-like product  
567 prepared from offal lamb (heart, liver, spleen, kidneys) firstly cut into small cubic pieces,  
568 seasoned with red hot pepper, garlic, coriander, mint and ginger (**Fig. S5C**). Sometimes, rice  
569 and chickpeas are also included in its preparation. The mixture is then stuffed into previously  
570 cleaned lamb stomach. The final aspect of *Osmana* (**Fig. 6**) is similar to that of *Kishka*, which  
571 refers to various types of sausage or stuffed intestine with a filling made from a combination of  
572 meat and meal, often a grain [94]. *Kishka* sausage is popular across Eastern Europe as well as  
573 with immigrant communities from those areas. During different events, namely “*Aid Al Adha*”,  
574 *Osmana* is served with couscous or in a sauce [35].

#### 575 **4.5.4. Bnadek [Product 19]**

576 *Bnadek* is a typical Tunisian specialty that is exclusively prepared from grounded meat  
577 firstly mixed with salt and dry-spices containing dry-mint, coriander, *h'rissa*, curcuma and  
578 black pepper (**Table 1**). The blend is subsequently shaped by hand into balls of desirable size  
579 that are fried in hot olive-oil for a short time (2 min) with frequent stirring (**Fig. S5D**). Then,  
580 the balls are covered with water and boiled for less than one hour until complete evaporation of  
581 the entire water [87]. The meatballs dipped in oil are conditioned in glass containers  
582 hermetically closed and stored at ambient temperature (**Fig. 6**). *Bnadek* owes its characteristic  
583 flavor to *h'rissa*, a Tunisian hot and spice mixture. *Bnadek* are usually served as appetizers  
584 even in a sandwich or added to a stew/sauce or soups. It is usually eaten by Tunisian peoples  
585 with *Kafteji* (fried vegetables) also known as *köfteci* in Turkey or with *Ojja* (scrambled eggs)  
586 [95].

#### 587 **4.5.5. Khlii [Product 20]**

588 *Khlii* is a typical and very popular Moroccan candied meat product prepared from boneless  
589 whole-tissue of beef, lamb, goat and camel meat (**Table 1**). According to [7], *Khlii* is probably  
590 brought to Morocco at the beginning of the 8<sup>th</sup> century by Arab warriors during Islamic  
591 expansions to Andalusia.

592 The preparation process of *Khlii* has been described in earlier studies [7, 56, 57]. The ethnic  
593 preparation diagram and final aspect of *Khlii* are given in **Fig. S5E** and **Fig. 6**, respectively.  
594 Briefly, boneless meat trimmed into strips of 5 – 10 cm are marinated in *Sharmula* that include  
595 salt, vinegar, cumin, seed oil, coriander and smashed garlic. After that, the mixture is kept in a

596 cool place with occasional stirring for one or two days. After this step, the cured meat strips are  
597 hung on a laundry rope or wire and sun-dried for at least one week. The dried meat strips are  
598 then boiled in a pot that contain water, animal fat and eventually olive oil with frequent stirring  
599 until complete evaporation of water. Following this preparation steps, three variants of *Khlii*  
600 are distinguishable. First, the “*Typical Khlii*”, which consists of whole strips of meat immersed  
601 in liquid animal fat, stored in containers of glass or plastic and preserved at ambient  
602 temperature. The small pieces of meat and *Sharmula* obtained after *Khlii* cooking are called  
603 “*Agrish*” which is the main ingredient of salty traditional pancakes. The third one is “*Diet*  
604 *Khlii*” which is the cooked meat strips dipped in olive oil as an alternative to animal fat.

605 It is judged healthier and may be it decreases the risks for cardiovascular diseases.  
606 Irrespective of its variants, *Khlii* is consumed as a ready-to-eat meat product, fried with eggs  
607 for breakfast. It is also used as an ingredient in different traditional dishes such as soups, and  
608 more recently, as a topping for pizza [39]. *Khlii* is now part of the menu in many Moroccan  
609 restaurants served with various *Tajine*. *Khlii* is considered as shelf stable meat product that can  
610 be preserved for more than 2 years at room temperature. However, lipid oxidation (rancidity  
611 flavor) and color stability (unattractive color) are major problems during storage of *Khlii*  
612 because the high content of animal or vegetal fat.

#### 613 **4.5.6. Kobiba [Product 21]**

614 *Kobiba* is a typical Egyptian popular meat product (**Table 1**) that is a deep fried meatball  
615 mostly served grilled or cooked with a sauce based on milk and flour [58]. *Kobiba* is usually  
616 prepared from ground beef or lamb meat kneaded with soft rice or *Burghul* (wheat semolina),  
617 onion and garlic and the whole is seasoned with pinches of cumin and several other spices  
618 (**Fig. S5F**). The meatballs are deep-fried at a medium heat turning until golden brown over  
619 (**Fig. 6**). *Kobiba* is similar to *Çiğ köfte*, a traditional Turkish meatballs prepared following the  
620 same way but consumed without cooking [72]. Several meatballs variants similar to *Kobiba* are  
621 described in many parts of the world such as *Kebba*, a traditional meat product prepared in  
622 Lebanon and Syria [58]. Finally, *Kobiba* is eaten as an appetizer with prepared salad or cooked  
623 rice.

#### 624 **4.5.7. Mcharmila/ Kemounia [Product 22]**

625 *Mcharmila*, also known as *Kemounia* is one of the most popular meat product prepared in  
626 the religious feast “*Aid Al Adha*” in Algeria and Morocco (**Table 1**). *Mcharmila* is a ready-to-  
627 eat meat product made exclusively from liver (**Fig. S5G**). After removing the blood vessels

628 and small skin, the liver is cut into small cubic pieces and mixed with a mixture of spices  
629 including red hot pepper, black pepper, cumin and coriander. Minced tomato and olive oil are  
630 further added to the mixture (**Fig. 6**). The whole is then covered and cooked for 20 to 30 min.  
631 *Mcharmila* is mainly prepared from lamb and beef liver, poultry offal can be also used. It is  
632 usually consumed with bread and at any time of the year.

#### 633 **4.5.8. Boubnit / Membar [Product 23]**

634 *Boubnit* also known as *Membar* depending on the country of origin, is a sausage-like  
635 product prepared using beef or lamb intestine that are previously cleaned and soaked in boiling  
636 water to be used as a natural casing (**Table 1**). Its preparation varies between countries and  
637 communities depending on the ingredients used and seasoning. Even the name differ, it is  
638 called “*Boubnit*” in Algeria and “*Membar*” in Egypt. In Algeria, *Boubnit* is a stuffed lamb or  
639 beef intestine with a mixture of semolina, chopped animal fat, dried grapes, smashed fresh  
640 garlic, salt, ginger, coriander, pepper, hot red pepper, olive oil and water (**Fig. S5H**). The  
641 stuffed intestine can be twisted at intervals to divide it into several separate sausages. It is then  
642 boiled in water with onion and spices that are generally the same used for seasoning. The final  
643 product is sliced and served alone or with sauce (**Fig. 6**). In Egypt, *Membar* is stuffed with  
644 ground beef, salt, chopped onion, fresh mint, fresh parsley, chopped fresh tomato, rice and  
645 some spices like coriander, pepper and dry paprika (**Fig. S5H** and **Fig. 6**). It is then covered  
646 with water and boiled in water for of one hour. After cooking, *Membar* is drained and fried in  
647 little butter [58]. In both countries, *Boubnit* or *Membar* is served immediately (as it crisps) and  
648 is mostly consumed as appetizer or in sauce.

#### 649 **4.5.9. Mkila [Product 24]**

650 *Mkila* is one of the most well-known Moroccan specialties (**Table 1**). It consists of cured  
651 and fried meat strips from all types of red meats [39]. Originally, the word *Mkila* derives from  
652 the term “*Makla*” in Arabic, which means “frying pan”, the utensil used to cook meat [7]. For  
653 its preparation, strips or pieces of meat are mixed with salt, spices and chopped animal fat (**Fig.**  
654 **S5I**). Then, the mixture is marinated all the day in cold place before being cooked in water  
655 until the meat is very tender. After that, the tender meat strips are fried in vegetable oil  
656 (preferentially olive oil) and animal fat until complete evaporation of water. The final product  
657 (**Fig. 6**) is conditioned with oil (where it has been cooked) in glass containers hermetically  
658 close and stored at ambient temperature for more than one year. Basically, *Mkila* is similar to a  
659 traditional Turkish meat product called “*Kavurma*” [72, 96]. These products are all considered  
660 as ready-to-eat meat products that can be consumed without further processing or cooking. In

661 Morocco, *Mkila* is usually served with various types of *Tajine* (a Maghrebian dish named after  
662 the earthenware pot where it is cooked). It is further called a *Maraq/Marqa* in North Africa and  
663 the Middle East. *Tajine* would also designate a braised stew of lamb or chicken or beef with  
664 vegetables eaten as well or served with couscous.

#### 665 **4.5.10. *Tehal/Tehane* [Product 25]**

666 *Tehal*, spelled also *Tehane* is another Moroccan traditional meat product specialty (**Table**  
667 **1**). *Tehal* is an Arabic word which means spleen, the primary ingredient of the product [7, 39].  
668 Thus, *Tehal* is a stuffed bovine/ovine spleen with ground beef, lamb or camel meat, olives,  
669 chopped fat and spices including coriander, ginger, fresh smashed garlic and hot red pepper  
670 (**Fig. S5J**). The stuffed spleen is mostly baked in a bread oven and this confers a soft and  
671 creamy texture to the final product (**Fig. 6**). For its consumption, sliced *Tehal* are griddled and  
672 served in a sandwich or with boiled rice.

#### 673 **4.5.11. *Ban-chems* [Product 26]**

674 *Ban-chems* is a typical Libyan meat product (**Table 1**). It is prepared from bovine offal  
675 (intestines, liver, lung, spleen, and kidney) that are cut into small pieces before mixing with  
676 chopped fat and spices (**Fig. S5K**). The mixture and the previously cleaned stomach are sun-  
677 dried separately. After drying, the stomach is stuffed with pieces of offal and subjected to a  
678 period of cooking before conditioning in animal fat. *Ban-chems* is commonly added as an  
679 ingredient in cooked *couscous* or served with pasta [7, 56].

#### 680 **4.5.12. *Bouzelouf/Zelif/ Kawareh / H'Rgma* [Product 27]**

681 *Bouzelouf* is mainly prepared in religious feasts such as “*Aid Al Adha*” (**Table 1**). *Bouzelouf*  
682 is known by other names, such as *Zelif* (in Morocco), *H'Rgma* or *Bouzelouf* (in Algeria),  
683 *Bouzelouf* (in Tunisia) and *Kawareh* (in Egypt) [97, 98]. After slaughter, lamb or beef head and  
684 lower part of legs are cleaned, flamed and scraped to remove the hair, then boiled before  
685 cutting (**Fig. S5L**). The pieces of head and legs are mixed with onion, garlic, coriander,  
686 caraway, red hot pepper and fresh parsley [93]. The whole is then covered with water and  
687 boiled until bones are easily separable (**Fig. 6**). *Bouzelouf* can be roasted with vegetables or  
688 served with a sauce. In Egypt, it is eaten as *Fettah Kawareh* (boneless head and legs) with  
689 cooked rice and the sauce where it was cooked can also be served as a soup known as “*Chorbat*  
690 *Kawareh*” that is mostly consumed in winter [58]. Currently, *Bouzelouf* is part of the menu in  
691 many popular restaurants in Algeria, namely in the localities near Constantine region.

#### 692 **4.5.13. *Klaya* [Product 28]**

693 *Klaya* is a Tunisian ready-to-eat meat product that is prepared from meat and offal of beef  
694 and lamb (**Table 1**). For its preparation, the meat, liver, kidney and fat are all cut into small  
695 cubic pieces and then boiled in a salted water for a moment (**Fig. S5M**). After boiling, the  
696 pieces are mixed with salt and a mixture of spices before frying in olive oil with frequent  
697 stirring until complete evaporation of water [98]. *Klaya* can be consumed immediately or  
698 conserved in glass containers that contain olive oil firstly served for its cooking (**Fig. 6**). *Klaya*  
699 is mainly prepared for family, during *Moussems* (an annual religious celebration) or weddings.

#### 700 **4.5.14. Bekbouka/ T'qalia / Douara [Product 29]**

701 *Bekbouka* is one of the famous dishes of the Maghreb countries (Morocco, Algeria and  
702 Tunisia), prepared from beef or lamb stomach (**Table 1**). Traditionally, after cleaning, the  
703 stomach is cut into small pieces and mixed with salt, fresh tomato, onions and spices including  
704 hot paprika, ginger, coriander, cumin, pepper and fresh garlic (**Fig. S5N** and **Fig. 6**). The  
705 mixture is cooked in water and olive oil until complete evaporation of the added water [39, 93,  
706 98]. This ready-to-eat meat product is consumed at any time of the year namely soon after “*Aid*  
707 *Al Adha*”. It is also prepared on the eve of weddings by the groom's family.

#### 708 **4.5.15. Tangia [Product 30]**

709 *Tangia*, is a typical Moroccan specialty, namely from the locality of Marrakech (**Table 1**). It  
710 is a slow-cooked meat prepared in an urn-shaped terra cotta cooking vessel (earthenware jar)  
711 called a “*Tangia*”. Thus, it is also the name of the stew cooked in the pot, and hence of the  
712 ethnic meat product, *Tangia*. Traditionally, *Tangia* is cooked in an oven adjacent to a *Hammam*  
713 (a communal bathhouse), where it would slow-cooked in the ashes from the fire used to heat  
714 the bathhouse [35]. To prepare *Tangia*, whole pieces of meat are mixed with onion, garlic,  
715 parsley or cilantro, spices and chopped preserved lemon rind (**Fig. S5O**). The cured meat is  
716 then transferred to the earthenware jar and covered with a circle of parchment paper (**Fig. 6**).  
717 The cooking is very long, approximately 6 to 7 hours. This popular ethnic meat product is  
718 usually served as a family dish on Friday with a selection steamed seasonal vegetables as well  
719 with bread [39, 99].

#### 720 **4.5.16. Mrouzia [Product 31]**

721 *Mrouzia* is a sweet and spicy Moroccan and Tunisian traditional meat product (**Table 1**). It  
722 is traditionally prepared in the days following the Islamic feast “*Aid Al Adha*” or during the  
723 fasting month of “*Ramadan*” due to its high calorie value [39]. This product originated from  
724 Spain and it was simmered for the first time in Andalusia, a few centuries ago [35]. For its  
725 preparation, the pieces of meat are mixed with salt and spices (*Ras El Hanout* and Saffron),

726 garlic and onion, then marinated overnight before cooking over medium heat, stirred  
727 occasionally to turn the meat as it browns (**Fig. S5P** and **Fig. 6**). After that, water is added and  
728 covered before it is simmered. After an approximate of two hours, drained raisins, honey, sugar  
729 and cinnamon are added. The pot is once again covered and let to simmer for 20 to 30 minutes,  
730 until the raisins are plump and the sauce is reduced to a thick syrup-like consistency [100]. In  
731 Tunisia, *Mrouzia* is prepared in the same way as in Morocco except that the Tunisian *Mrouzia*  
732 contains chickpeas. The characteristic taste of *Mrouzia* is due to saffron and "*Ras El Hanout*",  
733 a spice blend of cardamom, coriander seeds, nutmeg, cinnamon, pepper, clove, turmeric,  
734 ginger, and cumin. Caraway seeds, ground fennel and green anise can be also used. *Mrouzia*  
735 may be made a day or two in advance, as the flavors will continue to improve with time.  
736 Honey and sugar paly pivotal roles as preservatives, therefore, *Mrouzia* can be preserved more  
737 than 10 days. Thus, this ready-to-eat meat product is consumed with bread.

#### 738 **4.5.17. Cachir [Product 32]**

739 The sausage "*Cachir*" is the most prepared (both traditional and industrial scale) and  
740 consumed ready-to-eat meat product in Algeria (**Table 1**). The etymology of the word derived  
741 from Hebrew word "*Kasher*" that means "fit to be eaten", according to Jewish dietary laws.  
742 Historically, from the 18<sup>th</sup> and 19<sup>th</sup> century and during the presence of the French colons in  
743 Algeria, the Algerian *Jews* use the word "*Casher*" to distinguish their meat products from  
744 those of other European charcuteries, which are pork-based. This appreciated meat product is a  
745 cured and cooked sausage. Traditionally, it is prepared by mixing ground meat from beef,  
746 chicken, lamb or camel with eggs, salt, dry spices (paprika, cumin, caraway and black pepper),  
747 and fresh smashed garlic and pitted green olives (**Fig. S5Q**). The blend is stuffed into natural  
748 or synthetic casings that is then steamed. After complete cooking, casing is removed and to be  
749 eaten, the sausage is cut into slices (**Fig. 6**) after a chilling period. It is often used to garnish  
750 sandwiches. *Cachir* is to some extent similar in its aspect and taste to *Mortadella* and  
751 *Luncheon* sausages.

## 752 **5. Conclusion and future prospects**

753 This review listed the most popular traditional meat products of the North-African and  
754 Mediterranean countries. For the first time, 32 ethnic meat products were presented and their  
755 ethnic preparation diagrams were identified. The meat products were then grouped into 5 groups  
756 according to the preparation techniques used and their final aspects. In the North-African regions,  
757 meat products are not well-valorized and very little knowledge is available about them.  
758 Furthermore, the lack of commercial availability for most of the North-African meat products

759 and gradual decadence of the traditional practices due to globalization has led to the extinction of  
760 numerous ethnic meat products. Thus, it is imminent to consider the age-old knowledge  
761 regarding the culinary heritage, the ancestral food preparation practices and the nutritional value  
762 for their beneficial aspects attributable to belong to the Mediterranean diet. However, the  
763 traditional food products would play important role in tourism and other social and economic  
764 aspects of the North-African countries. For these, their characterization for both physic-chemical,  
765 technological and microbiological aspects are needed for most of the listed meat products in this  
766 review since only some of them were slightly characterized. Thus, it is of great importance to  
767 revive and save the preparation steps or diagrams of the 32 traditional meat products for the  
768 future generations. It would be also useful to conduct further studies to identify those, which are  
769 not identified in this work due to the complexity of the North-African and Mediterranean  
770 countries for their high number of ethnic groups and the vast area they occupy. On another hand,  
771 as a response to the emerging negative perceptions of consumers related to ethnic meat  
772 products, sensory studies would be conducted for better promotion of the products. All these  
773 guidelines would be beneficial in order to increase the cultural treasures of North-African and  
774 Mediterranean countries.

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783 The authors declare that no competing interests exist.

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#### 787 **References**

- 788 1. Leroy, F., et al., *Meat fermentation at the crossroads of innovation and tradition: A*  
789 *historical outlook*. Trends in Food Science & Technology, 2013. **31**(2): p. 130-137.
- 790 2. Toldrá, F., *ETHNIC MEAT PRODUCTS | Mediterranean*, in *Encyclopedia of Meat*  
791 *Sciences (Second Edition)*. 2014, Academic Press: Oxford. p. 550-552.

- 792 3. Zeng, W., et al., *Chinese ethnic meat products: Continuity and development*. Meat  
793 Science, 2016. **120**: p. 37-46.
- 794 4. Rather, S.A., F.A. Masoodi, and R. Akhter, *Ethnic meat products of Kashmiri wazwan:  
795 a review*. Journal of Ethnic Foods, 2016. **3**(4): p. 246-250.
- 796 5. Rai, A.K., J.P. Tamang, and U. Palni, *Microbiological studies of ethnic meat products  
797 of the Eastern Himalayas*. Meat Science, 2010. **85**(3): p. 560-567.
- 798 6. Campos, S.D., et al., *Nutritional value and influence of the thermal processing on a  
799 traditional Portuguese fermented sausage (alheira)*. Meat Science, 2013. **93**(4): p. 914-  
800 918.
- 801 7. Benkerroum, N., *Traditional Fermented Foods of North African Countries: Technology  
802 and Food Safety Challenges With Regard to Microbiological Risks*. Comprehensive  
803 Reviews in Food Science and Food Safety, 2013. **12**(1): p. 54-89.
- 804 8. Boudechicha, H.R., et al. *Khliia Ezir, a traditional cured meat product of Algeria:  
805 Preparation and characterization in Proceedings of the 61<sup>th</sup> International Congress of  
806 Meat Science and Meat Technology*. 2015. Clermont-Ferrand, France.
- 807 9. Boudechicha, H.R., et al., 92. *Adoption of proteomics in traditional meat products: the  
808 case of Khliia Ezir*, in *Food futures: ethics, science and culture*. 2016. p. 600-606.
- 809 10. Boudechicha, H.-R., et al., *Microbiological changes during the preparation steps of  
810 Khliia Ezir: a traditional cured meat product of Algeria*. Integr Food Nutr Metab,  
811 2017. **4**(6): p. 1-5.
- 812 11. Boudechicha, H.-R., *Khliia Ezir, un produit carné traditionnel Algérien*, in INATAA.  
813 2014, Université Frères Mentouri Constantine p. 140.
- 814 12. ESSID, I., et al., *Characterization and technological properties of Staphylococcus  
815 xylosus strains isolated from a Tunisian traditional salted meat*. Meat Sci, 2007. **77**(2):  
816 p. 204-12.
- 817 13. ESSID, I., M. Medini, and M. Hassouna, *Technological and safety properties of  
818 Lactobacillus plantarum strains isolated from a Tunisian traditional salted meat*. Meat  
819 Sci, 2009. **81**(1): p. 203-8.
- 820 14. ESSID, I. and M. Hassouna, *Effect of inoculation of selected Staphylococcus xylosus and  
821 Lactobacillus plantarum strains on biochemical, microbiological and textural  
822 characteristics of a Tunisian dry fermented sausage*. Food Control, 2013. **32**(2): p. 707-  
823 714.
- 824 15. Triki, M., et al., *Effect of preformed konjac gels, with and without olive oil, on the  
825 technological attributes and storage stability of merguez sausage*. Meat Science, 2013.  
826 **93**(3): p. 351-360.
- 827 16. Cherroud, S., et al., *Microbiological and physicochemical characterization of dry-  
828 cured Halal goat meat. Effect of salting time and addition of olive oil and paprika  
829 covering*. Meat Sci, 2014. **98**(2): p. 129-34.
- 830 17. Bennani, L., et al., *Physico-chemical and microbiological characteristics of a dried  
831 salted meat product (Kaddid) in Morocco*. Z Lebensm Unters Forsch, 1995. **201**(6): p.  
832 528-32.
- 833 18. Bennani, L., M. Faid, and A. Bouseta, *Experimental manufacturing of kaddid, a salted  
834 dried meat product: control of the microorganisms*. European Food Research and  
835 Technology, 2000. **211**(3): p. 153-157.
- 836 19. Nam, K.-C., C. Jo, and M. Lee, *Meat products and consumption culture in the East*.  
837 Meat Science, 2010. **86**(1): p. 95-102.
- 838 20. Jiménez-Colmenero, F., J. Carballo, and S. Cofrades, *Healthier meat and meat  
839 products: their role as functional foods*. Meat Science, 2001. **59**(1): p. 5-13.
- 840 21. Issanchou, S., *Consumer expectations and perceptions of meat and meat product  
841 quality*. Meat Sci, 1996. **43S1**(0): p. 5-19.

- 842 22. Guerrero, L., et al., *Consumer-driven definition of traditional food products and*  
 843 *innovation in traditional foods. A qualitative cross-cultural study.* *Appetite*, 2009.  
 844 **52**(2): p. 345-354.
- 845 23. Feiner, G., *13 - Typical cooked sausage products from around the world*, in *Meat*  
 846 *Products Handbook*. 2006, Woodhead Publishing. p. 287-296.
- 847 24. Talon, R., et al., *Traditional dry fermented sausages produced in small-scale*  
 848 *processing units in Mediterranean countries and Slovakia. 1: Microbial ecosystems of*  
 849 *processing environments.* *Meat Science*, 2007. **77**(4): p. 570-579.
- 850 25. Laranjo, M., et al., *Traditional Meat Products: Improvement of Quality and Safety.*  
 851 *Journal of Food Quality*, 2017. **2017**: p. 2.
- 852 26. Trichopoulou, A., S. Soukara, and E. Vasilopoulou, *Traditional foods: a science and*  
 853 *society perspective.* *Trends in Food Science & Technology*, 2007. **18**(8): p. 420-427.
- 854 27. Almlı, V.L., et al., *General image and attribute perceptions of traditional food in six*  
 855 *European countries.* *Food Quality and Preference*, 2011. **22**(1): p. 129-138.
- 856 28. Lentz, C., *Changing food habits: case studies from Africa, South America and Europe.*  
 857 1999: Taylor & Francis.
- 858 29. Civitello, L., *Cuisine and culture: A history of food and people.* 2011: John Wiley &  
 859 Sons.
- 860 30. Farouk, M.M., *Advances in the industrial production of halal and kosher red meat.*  
 861 *Meat Sci*, 2013. **95**(4): p. 805-20.
- 862 31. Farouk, M.M., et al., *Spiritual aspects of meat and nutritional security: Perspectives*  
 863 *and responsibilities of the Abrahamic faiths.* *Food Research International*, 2015. **76**(0):  
 864 p. 882-895.
- 865 32. Stearns, P.N., M. Adas, and S.B. Schwartz, *World Civilizations: The Global*  
 866 *Experience.* 2010: Longman.
- 867 33. Heine, P., *Food Culture in the Near East, Middle East, and North Africa.* 2004:  
 868 Greenwood Press.
- 869 34. MacVeigh, J., *International Cuisine.* 2008: Cengage Learning.
- 870 35. Samrakandi, M.-H. and G. Carantino, *Manger au Maghreb.* 2009: Presses Univ. du  
 871 Mirail.
- 872 36. Bennett, E.L., *Is There a Link between Wild Meat and Food Security?* *Conservation*  
 873 *Biology*, 2002. **16**(3): p. 590-592.
- 874 37. Strydom, P.E., *ETHNIC MEAT PRODUCTS | Africa A2 - Jensen, Werner Klinth*, in  
 875 *Encyclopedia of Meat Sciences.* 2004, Elsevier: Oxford. p. 440-441.
- 876 38. Prakash, V., *Chapter 1 - Introduction: The Importance of Traditional and Ethnic Food*  
 877 *in the Context of Food Safety, Harmonization, and Regulations*, in *Regulating Safety of*  
 878 *Traditional and Ethnic Foods.* 2016, Academic Press: San Diego. p. 1-6.
- 879 39. Smires, L.B., *La Cuisine Marocaine: Algérie, Tunisie, Liban, France, Italie, Espagne,*  
 880 *Grèce et plus de 75 recettes supplémentaires.* 2007: La Société d'Édition et de  
 881 Diffusion Al Madariss.
- 882 40. Al-Delaimy, K.H.S. and M.M.F. Barakat, *Antimicrobial and preservative activity of*  
 883 *garlic on fresh ground camel meat: I.—Effect of fresh ground garlic segments.* *Journal*  
 884 *of the Science of Food and Agriculture*, 1971. **22**(2): p. 96-98.
- 885 41. Farouk, M.M. and A.E.-D. Bekhit, *12 Processed Camel Meats.* *Camel Meat and Meat*  
 886 *Products*, 2012. **91**: p. 186.
- 887 42. Skibsted, L., *Cured meat products and their oxidative stability.* *SPECIAL*  
 888 *PUBLICATION-ROYAL SOCIETY OF CHEMISTRY*, 1992. **106**: p. 266-266.
- 889 43. Toldrá, F., *Principles of Dry-Fermented Sausage-Making*, in *Dry-Cured Meat*  
 890 *Products.* 2008, Food & Nutrition Press, Inc. p. 63-88.
- 891 44. Cassens, R.G., *Meat Preservation: Preventing Losses and Assuring Safety.* 2008:  
 892 Wiley.

- 893 45. Toldrá, F., *CURING / Dry*, in *Encyclopedia of Meat Sciences (Second Edition)*, M.  
894 Dikeman and C. Devine, Editors. 2014, Academic Press: Oxford. p. 425-429.
- 895 46. Kurlansky, M., *Salt*. 2011: Random House.
- 896 47. Barat, J.M., et al., *Accelerated processing of dry-cured ham. Part I. Viability of the use*  
897 *of brine thawing/salting operation*. *Meat Science*, 2006. **72**(4): p. 757-765.
- 898 48. Baxter, R. and W.H. Holzapfel, *A Microbial Investigation of Selected Spices, Herbs,*  
899 *and Additives in South Africa*. *Journal of Food Science*, 1982. **47**(2): p. 570-574.
- 900 49. Kivanç, M., *Antimicrobial activity of "Çörtük" (Echinophora sibthorpiana Guss.)*  
901 *spice, its essential oil and methyl-eugenol (Short communication)*. *Food / Nahrung*,  
902 1988. **32**(6): p. 635-637.
- 903 50. Fernandes, R., *Microbiology Handbook: Dairy Products*. 2009: Royal Society of  
904 Chemistry.
- 905 51. Zaika, L.L., *SPICES AND HERBS: THEIR ANTIMICROBIAL ACTIVITY AND ITS*  
906 *DETERMINATION*. *Journal of Food Safety*, 1988. **9**(2): p. 97-118.
- 907 52. Careaga, M., et al., *Antibacterial activity of Capsicum extract against Salmonella*  
908 *typhimurium and Pseudomonas aeruginosa inoculated in raw beef meat*. *International*  
909 *Journal of Food Microbiology*, 2003. **83**(3): p. 331-335.
- 910 53. Igene, J., *Traditional African meat Products for food security and agro-*  
911 *industrialization: development challenges*. Lambert Acad. Publ., Germany. 2009b,  
912 2008. **250**.
- 913 54. Gayler, P. and L. Edwards, *Sausages: Mouthwatering Recipes from Merguez to*  
914 *Mortadella*. 2011: Lyons Press.
- 915 55. Benkerroum, N., et al., *Occurrence of Shiga toxin-producing Escherichia coli O157 in*  
916 *selected dairy and meat products marketed in the city of Rabat, Morocco*. *J Food Prot*,  
917 2004. **67**(6): p. 1234-7.
- 918 56. Daoudi, A., et al., *Les produits charcutiers halal: Charcuterie et préparations*  
919 *boucheres*. Conflandey: MAE-ERTI. p, 2006. **492**.
- 920 57. Bennani, L., *Qualité de certains produits carnés traditionnels marocains: étude*  
921 *microbiologique, physico-chimique et amélioration de la technologie de fabrication*.  
922 2003.
- 923 58. El-Magoli, S.B.M. and M.A. Abd-Allah, *ETHNIC MEAT PRODUCTS / Middle East*, in  
924 *Encyclopedia of Meat Sciences (Second Edition)*. 2014, Academic Press: Oxford. p.  
925 553-554.
- 926 59. Zukál, E. and K. Incze, *Drying*, in *Handbook of Meat Processing*. 2010, Wiley-  
927 Blackwell. p. 219-229.
- 928 60. Lewicki, P.P., et al., *DRYING*, in *Encyclopedia of Meat Sciences (Second Edition)*.  
929 2014, Academic Press: Oxford. p. 471-479.
- 930 61. Chabbouh, M., A. Sahli, and S. Bellagha, *Does the spicing step affect the quality and*  
931 *drying behaviour of traditional kaddid, a Tunisian cured meat?* *J Sci Food Agric*, 2013.  
932 **93**(14): p. 3634-41.
- 933 62. Aguirrezábal, M.M., et al., *The effect of paprika, garlic and salt on rancidity in dry*  
934 *sausages*. *Meat Science*, 2000. **54**(1): p. 77-81.
- 935 63. Gailani, M.B. and D.Y.C. Fung, *Microbiology and Water Activity Relationship in the*  
936 *Processing and Storage of Sudanese Dry Meat (Sharmoot)*. *Journal of Food Protection*,  
937 1989. **52**(1): p. 13-20.
- 938 64. Rust, R.E. and C.L. Knipe, *ETHNIC MEAT PRODUCTS / North America*, in  
939 *Encyclopedia of Meat Sciences (Second Edition)*, M. Dikeman and C. Devine, Editors.  
940 2014, Academic Press: Oxford. p. 555-557.
- 941 65. Zdolec, N., *Fermented Meat Products: Health Aspects*. 2017: CRC Press.
- 942 66. Hui, Y., et al., *Handbook of Fermented Meat and Poultry*. 2014: John Wiley & Sons.

- 943 67. Lücke, F.-K., *Fermented meat products*. Food Research International, 1994. **27**(3): p.  
944 299-307.
- 945 68. Rantsiou, K. and L. Cocolin, *Fermented Meat Products*, in *Molecular Techniques in the*  
946 *Microbial Ecology of Fermented Foods*, L. Cocolin and D. Ercolini, Editors. 2008,  
947 Springer New York: New York, NY. p. 91-118.
- 948 69. Lücke, F.-K., *Utilization of microbes to process and preserve meat*. Meat Science,  
949 2000. **56**(2): p. 105-115.
- 950 70. Kalalou, I., M. Faid, and T. Ahami, *Improving the quality of fermented camel sausage*  
951 *by controlling undesirable microorganisms with selected lactic acid bacteria*. Int. J.  
952 Agric. Biol, 2004. **6**: p. 447-451.
- 953 71. Özbey, G., F. Kök, and A. Muz, *Isolation of Salmonella spp. in camel sausages from*  
954 *retail markets in Aydın, Turkey, and polymerase chain reaction (PCR) confirmation*.  
955 Turkish Journal of Veterinary and Animal Sciences, 2007. **31**(1): p. 67-71.
- 956 72. Kilic, B., *Current trends in traditional Turkish meat products and cuisine*. LWT - Food  
957 Science and Technology, 2009. **42**(10): p. 1581-1589.
- 958 73. Kaya, M. and H.Y. Gökalp, *The effects of starter cultures and different nitrite doses on*  
959 *the growth of Listeria monocytogenes in sucuk production*. Turkish Journal of  
960 Veterinary and Animal Sciences, 2005. **28**(6): p. 1121-1127.
- 961 74. Bloukas, J.G., E.D. Paneras, and G.C. Fournitzis, *Effect of replacing pork backfat with*  
962 *olive oil on processing and quality characteristics of fermented sausages*. Meat  
963 Science, 1997. **45**(2): p. 133-144.
- 964 75. Kabak, B. and A.D.W. Dobson, *An Introduction to the Traditional Fermented Foods*  
965 *and Beverages of Turkey*. Critical Reviews in Food Science and Nutrition, 2011. **51**(3):  
966 p. 248-260.
- 967 76. El-Khateib, T., *Microbiological Status of Egyptian Salted Meat (Basterma) and Fresh*  
968 *Sausage*. Journal of Food Safety, 1997. **17**(3): p. 141-150.
- 969 77. Aktaş, N., M.I. Aksu, and M. Kaya, *Changes in myofibrillar proteins during processing*  
970 *of pastirma (Turkish dry meat product) produced with commercial starter cultures*.  
971 Food Chemistry, 2005. **90**(4): p. 649-654.
- 972 78. Akkose, A. and N. Aktas, *Curing and diffusion coefficient study in pastirma, a Turkish*  
973 *traditional meat product*. Meat Sci, 2014. **96**(1): p. 311-4.
- 974 79. ABD-ALLAH, S. and H. Ismail, *Quality Profile of The Semi-Dry Egyptian Salted Meat*  
975 *(Basterma) Available in Markets of Assiut City*. Assiut Veterinary Medical Journal.  
976 **58**(135): p. 79-87.
- 977 80. Çakıcı, N., M.İ. Aksu, and E. Erdemir, *A survey of the physico-chemical and*  
978 *microbiological quality of different pastirma types: a dry-cured meat product*. CyTA -  
979 Journal of Food, 2015. **13**(2): p. 196-203.
- 980 81. Tóth, L. and K. Potthast, *Chemical Aspects of the Smoking of Meat and Meat Products*,  
981 in *Advances in Food Research*, C.O. Chichester, E.M. Mraak, and B.S. Schweigert,  
982 Editors. 1984, Academic Press. p. 87-158.
- 983 82. Honikel, K.O., *Curing*, in *Handbook of Meat Processing*. 2010, Wiley-Blackwell. p.  
984 125-141.
- 985 83. Ruiter, A., *Color of smoked foods*. Food Technology, 1979. **33**(5): p. 54-&.
- 986 84. Anifantaki, K., et al., *THE EFFECT OF SMOKING, PACKAGING AND STORAGE*  
987 *TEMPERATURE ON THE BACTERIAL GREENING OF FRANKFURTERS CAUSED*  
988 *BY LEUCONOSTOC MESENTEROIDES SUBSP. MESENTEROIDES*. Italian Journal  
989 of Food Science, 2002. **14**(2): p. 135.
- 990 85. Šimko, P., *Determination of polycyclic aromatic hydrocarbons in smoked meat*  
991 *products and smoke flavouring food additives*. Journal of Chromatography B, 2002.  
992 **770**(1): p. 3-18.

- 993 86. Løvdal, T., *The microbiology of cold smoked salmon*. Food Control, 2015. **54**: p. 360-  
994 373.
- 995 87. Salloum, H. and S. Lim, *Arabian Nights Cookbook: From Lamb Kebabs to Baba*  
996 *Ghanouj, Delicious Homestyle Arabian Cooking*. 2012: Tuttle Publishing.
- 997 88. Boesen, E. and L. Marfaing, *Les nouveaux urbains dans l'espace Sahara-Sahel: un*  
998 *cosmopolitisme par le bas*. 2007: KARTHALA Editions.
- 999 89. Lopez, C.M., et al., *Identification of small peptides arising from hydrolysis of meat*  
1000 *proteins in dry fermented sausages*. Meat Sci, 2015. **104**(0): p. 20-9.
- 1001 90. Vignolo, G., C. Fontana, and S. Fadda, *Semidry and Dry Fermented Sausages*, in  
1002 *Handbook of Meat Processing*. 2010, Wiley-Blackwell. p. 379-398.
- 1003 91. Seman, D.L., et al., *Modeling the growth of Listeria monocytogenes in cured ready-to-*  
1004 *eat processed meat products by manipulation of sodium chloride, sodium diacetate,*  
1005 *potassium lactate, and product moisture content*. J Food Prot, 2002. **65**(4): p. 651-8.
- 1006 92. Borch, E. and P. Arinder, *Bacteriological safety issues in red meat and ready-to-eat*  
1007 *meat products, as well as control measures*. Meat Science, 2002. **62**(3): p. 381-390.
- 1008 93. Hadjiat, S., *La cuisine maghrébine*. 1987: Entreprise nationale du livre.
- 1009 94. Cassidy, F.G. and J.H. Hall, *Dictionary of American Regional English*. 1996: Belknap  
1010 Press of Harvard University Press.
- 1011 95. Kraig, B. and C.T. Sen, *Street Food Around the World: An Encyclopedia of Food and*  
1012 *Culture*. 2013: Abc-clio.
- 1013 96. Yetim, H., et al., *The effects of nitrite on the survival of Clostridium sporogenes and the*  
1014 *autoxidation properties of the Kavurma*. Meat Science, 2006. **72**(2): p. 206-210.
- 1015 97. Hacherouf, A., *Evolution historique et comparative de la consommation alimentaire*  
1016 *dans les pays du Maghreb central: Algérie, Maroc, Tunisie*. Vol. 19. 1993: CIHEAM-  
1017 IAM.
- 1018 98. Aubaile-Sallenave, F., *La Méditerranée, une cuisine, des cuisines*. Social Science  
1019 Information, 1996. **35**(1): p. 139-194.
- 1020 99. Koehler, J., *Morocco: A Culinary Journey with Recipes from the Spice-Scented*  
1021 *Markets of Marrakech to the Date-Filled Oasis of Zagora*. 2012: Chronicle Books  
1022 LLC.
- 1023 100. Hal, F., *Le grand livre de la cuisine marocaine*. 2005: Hachette Pratique.
- 1024 101. Kadim, I.T., *Camel meat and meat products*. 2013, Wallingford: CABI.
- 1025 102. Malti, J.E. and H. Amarouch, *Microbiological and Physicochemical Characterization*  
1026 *of Natural Fermented Camel Meat Sausage*. Journal of Food Processing and  
1027 Preservation, 2008. **32**(2): p. 159-177.

## Figure captions

**Fig. 1.** Map of the geographical distribution of the most common and 32 listed ethnic meat products of the North-African and Mediterranean countries prepared in special or different countries. They are grouped and identified by colors according to the proposed classification that is based on the traditional preparation types. Each circle number refers to the name of the traditional meat product given in the legend of the map.

● **I. Salted and/or marinated meat products but not dried:** grouped (1) *Melfouf* (*Boulfaf* / *Zenan*), (2) *Merguez* and (3) *Kofta* (*Kufta*/*Kabab*/*Kefta*).

● **II. Dried not fermented meat products:** grouped (4) Typical *Gueddid*, (*Kadid*), (5) Cured *Gueddid*, (6) *El M'selli*, (7) *Kourdass* and (8) *Tidkit*.

● **III. Fermented semi-dry/dried meat products:** grouped (9) *Soudjouk* (*Sucuk*/*Nakanek*), (10) *Boubnita* and (11) *Pastirma* (*Basturma*).

● **IV. Smoked meat products:** grouped (12) *Fregate*, (13) *Bourdim* (*Merdouma*/*Mandi*), (14) *Tarfa-Gara* and (15) *Maynama*.

● **V. Cooked and/or candied meat products:** grouped (16) *Khliia Ezir*, (17) *Laknaf*, (18) *Osbana* (*Osbane*), (19) *Bnadek*, (20) *Khlii*, (21) *Kobiba*, (22) *Mcharmila*, (23) *Boubnit* / *Membar*, (24) *Mkila*, (25) *Tehal*/*Tehane*, (26) *Ban-chems*, (27) *Bouzelouf* (*Zelif*/*Kawareh*), (28) *Klaya*, (29) *Bekbouka*/*T'qalia*/*Douara*, (30) *Tangia*, (31) *Mrouzia* and (32) *Cachir*.

**Fig. 2.** Photographs of *Melfouf*/*Boulfaf*, *Merguez* and *Kofta* ethnic meat products. These ethnic North-African meat products are classified in the category I. *Salted and/or marinated meat products but not dried*. *Melfouf* is prepared from liver lamb that is slowly roasted under an open hearth. *Merguez* is generally made of lean and fat lamb, beef and buffalo mixed with condiments. For its preparation ground meat is mixed with spices and then stuffed into natural casing namely from lamb intestine. *Kofta* is a ready-to-eat meat product that is prepared from ground meat by charbroiling: the boneless lean meat is minced and mixed with spices, herbs and smashed onions and the blend is usually formed into cigar-shape and left at least 2 hours before cooking. The indigenous methods of preparation of these meat products are given in **Fig. S1**.

**Fig. 3.** Photographs of *Gueddid* in Arabic or *Achedlouh* in Tamazight language (the language of the Berbers) and *Kourdass* ethnic meat products. These North-African ethnic meat products are grouped in the category II. *Dried not fermented meat products*. *Gueddid* is a well-known salted and sun-dried traditional meat product prepared in the Maghreb countries most often after “*Aid Al Adha*”. *Gueddid* or *Achedlouh* and its variants are prepared from many types of red meats including camel meat and any part of the carcass is used. *Kourdass* is a sausage-like product prepared from offal lamb using stomach, intestines, liver, lung, spleen and fat. The indigenous methods of preparation of these meat products are given in **Fig. S2**.

**Fig. 4.** Photographs of *Soudjouk*/*Sucuk*/*Nakanek*, *Boubnita* and *Pastirma* ethnic meat products. These North-African ethnic meat products are grouped in the category III.

*Fermented semi-dry/dried meat products.* *Soudjouk* or *Sucuk* is a cured, dry fermented and uncooked sausage of Turkish origin that is made entirely from beef or water buffalo, camel and lamb meat. *Boubnita* is a typical Moroccan dry fermented sausage prepared and consumed mostly after the religious feast “*Aid Al Adha*”. *Pastirma* is a ready-to-eat meat product commonly prepared and consumed in Egypt and its traditional preparation process takes several weeks and includes three well-defined steps: salting, pressing and finally drying and ripening. The indigenous methods of preparation of these meat products are given in **Fig. S3**.

**Fig. 5.** Photographs of *Merdouma/Mandi/Bourdim* and *Maynama* ethnic meat products. These North-African ethnic meat products are grouped in the category IV. *Smoked meat products.* *Merdouma* is one of the most popular ready-to-eat meat products made from a whole carcass of young and small sized lamb/goat or whole pieces of beef meat that is incised and mixed with salt and a set of spices. To make *Merdouma*, the cuts are cooked in a *Tandoor* (known also as a *Taboon*), which is a special kind of oven presented as a hole dug in the ground and covered inside by clay. *Maynama*, a traditional Algerian meat product, that is a ready-to-eat roasted spicy whole-tissue beef, lamb, goat or camel meat. Its preparation is similar to that of *Merdouma*, which consists on trimming, seasoning and smoking. The indigenous methods of preparation of these meat products are given in **Fig. S4**.

**Fig. 6.** Photographs of *Khliia Ezir* [the earthenware jar (*Ezir*) on the top and the final ready-to-eat meat product (*Khliia*) in the bottom], *Osmana*, *Bnadek*, *Khlii*, *Kobiba*, *Mcharmila*, *Boubnita*, *Member*, *Mkila*, *Tehal/Tehane*, *Bouzelouf (Zelif)*, *Klaya*, *Douara/Bekbouka/T'qalia* (showing two different final aspects), *Tangia*, *Mrouzia* and *Cachir* ethnic meat products. These North-African ethnic meat products are grouped in the category V. *Cooked and/or candied meat products.* The preparation, consumption and socio-cultural aspects of all these meat products are detailed in the text one by one and all summarized in **Table 1**. Furthermore, the indigenous methods of preparation of these meat products are given in **Fig. S5**.

**Table 1.** List of the 32 most common ethnic meat products of the North-African and Mediterranean countries prepared in special or different countries (distribution), which, are grouped according to their classification, based on the traditional preparation type.

Number	Meat product	Country	Livestock source	Main ingredients	Steps of preparation	Traditional product uses	References
<b>I. Salted and/or marinated meat products but not dried</b>							
1	<i>Melfouf (Boulfaf / Zenan)</i>	Algeria Morocco	Lamb	Salt, Pepper, Hot red pepper	Trimming, Cutting, Seasoning, Roasting	Ready-to-eat meat product prepared during the religious feast “ <i>Aid Al Adha</i> ,” after the sacrifice of the sheep. It is mainly consumed with bread.	
2	<i>Merguez</i>	Algeria Tunisia Morocco	Lamb Beef Buffalo Poultry	Salt Spices	Grinding, Mixing, Stuffing	Usually fried or barbecued to prepare sandwiches. It can be also used as an ingredient in traditional dishes such as “couscous.”	[34, 54, 55, 57]
3	<i>Kofta, Kufta (Kabab), Kefta</i>	Egypt Libya Tunisia Algeria Morocco	Lamb Beef Poultry	Salt, Spices (coriander, caraway, curcumin, black pepper), Smashed onion, Fresh minced garlic, Minced parsley, Olive oil	Mincing, Mixing, Grilling, Roasting	The product is generally served immediately with pita bread, tahini (a sauce) or with cooked rice.	[34, 58]
<b>II. Dried not fermented meat products</b>							
4	<i>Typical Guedid, (Kadid / Achedlouh)</i>	Algeria Morocco Tunisia	Beef, Lamb, Goat, Camel	Salt	Trimming, Salting, Sun-drying	Initially these variant of Guedid products are prepared to preserve meat. They are used as ingredients in various dishes (couscous, legume stews, aiche and avissar in Kabylia) prepared when meat is not available, likely during winter.	[7, 17, 18]
5	<i>Cured Guedid</i>	Algeria Morocco Tunisia	Beef, Lamb, Goat, Camel	Salt, Spices (fresh garlic, hot red pepper, mint, coriander)	Trimming, Cutting, Salting, Curing, Sun-drying	Consumed as a stew/sauce	[12, 101]
6	<i>El M'selli</i>	Algeria	Beef Lamb	Salt, Pepper, Fresh garlic, Hot red pepper, Coriander	Cutting, Salting and curing, Sun-drying, Ripening in melted bovine fat		[11]
7	<i>Kourdass</i>	Algeria Morocco	Lamb	Salt, Cumin, Hot red pepper, Garlic, Black pepper	Cutting, Seasoning, Stuffing, Sun-drying	Prepared during <i>Moussems (an annual religious celebration)</i> with other traditional dishes.	[7, 56]
8	<i>Tidkit</i>	Morocco	Lamb Beef Camel	Salt Spices	Seasoning, Sun-drying, Chopping	<i>Tidkit</i> is mainly used to prepare soups and sauces.	

Table 1. Continued

III. Fermented semi-dry/dried meat products						
9	<i>Soudjouk, Suçuk, Nakanek</i>	Egypt	Lamb, Beef, Buffalo, Camel	Salt Spices	Mincing, Mixing, Stuffing, Ripening	The product is eaten and used as sliced breakfast ingredient (with eggs or cheese) or included in a sandwich filling. [58, 101, 102]
10	<i>Boubnita</i>	Morocco	Lamb	Salt Spices	Cutting, Seasoning, Drying, Fermentation	Consumed in a sauce with vegetable or with pasta [7, 56]
11	<i>Pastirma (Basturma)</i>	Egypt	Beef, Lamb, Goat, Camel	Salt, Cemen, Freshly ground garlic, Fenugreek, Paprika, Mustard, Water, Cumin, Coriander	Trimming, Cutting, Curing, Pressing, Drying	It is consumed with scrambled eggs. It can be cut into slices, or fried or grilled lightly over a charcoal fire or can be used, more recently, as a topping for pizza. [58, 101]
IV. Smoked meat products						
12	<i>Fregate</i>	Algeria	Camel	Salt, Spices and condiments (onion, garlic, coriander, hot red pepper)	Cutting, Salting, Sun-drying, Smoking	Consumed in the Sahara region with a traditional bread known as <i>Mella</i> . [11]
13	<i>Merdouma (Bourdim/Mandi)</i>	Egypt Libya Algeria	Beef, Lamb, Camel, Goat, Poultry	Salt Spices	Seasoning, Smoking	The product is considered as the main dish served during special events, such as weddings and feasts. It is formerly served with cooked rice or wheat. [87]
14	<i>Tarfa-Gara</i>	Algeria	Lamb Camel	Salt Spices	Cutting, Seasoning, Smoking	/
15	<i>Maynama</i>	Algeria	Lamb, Beef, Goat, Camel	Salt Spices	Seasoning, Smoking	Consumed after hunting [88]
V. Cooked and/or candied meat products						
16	<i>Khliiaa Ezir</i>	Algeria	Beef, Lamb, Goat, Camel	Salt, Coriander, Caraway, Fresh garlic, Olive oil, Animal fat	Trimming, Curing, Cooking, Ripening in earthenware jar	The product is eaten as an appetizer in Constantine region or added to traditional dishes such as <i>Chakhchoukha</i> and <i>aiche</i> served during feasts. [8-11]
17	<i>Laknaf</i>	Algeria	Beef Lamb	Salt, Fresh garlic, Cumin, Coriander	Trimming, Cutting, Salting, Curing, Cooking	Consumed with <i>Sfenj</i> (a fried donut), or added as an ingredient to various culinary preparations such as lentils and chickpeas. [11]
18	<i>Osbanda (Osbane)</i>	Algeria Tunisia Libya Morocco	Lamb	Salt, Spices (red hot pepper, garlic, coriander, mint, ginger), Rice, Chickpea	Cutting, Seasoning, Stuffing, Cooking	The product is served with couscous or in a sauce. /

Table 1. Continued

19	<i>Bnadek</i>	Tunisia	Lamb Beef	Salt, Dry-mint, Coriander, H'rissa (hot sauce), Curcuma, Black pepper	Grinding, Mixing, Cooking	Consumed as an appetizer or added to a stew/sauce or soups. [87]
20	<i>Khlii</i>	Morocco	Beef, Lamb, Goat, Camel	Salt, Vinegar, Cumin, Seed oil, Coriander, Smashed garlic	Trimming, Cutting, Curing, drying, Cooking, Conditioning	Consumed such a ready-to-eat meat product or fried with eggs for breakfast. It is used in different traditional dishes such as soups, tajine and couscous or, more recently, as a topping for pizza. [7, 39, 57]
21	<i>Kobiba</i>	Egypt	Lamb Beef	Salt, Spices, Condiments	Grinding, Mixing, Frying	Is eaten as an appetizer with prepared salad or cooked rice. [58]
22	<i>Mcharmila</i>	Algeria Morocco	Lamb Beef Poultry	Salt, Spices (red hot pepper, black pepper, cumin, coriander), Olive oil, Minced tomato	Cutting, Seasoning, Cooking	Served during "Aid Al Adha" (religious feast). It is very popular in Algeria where it is consumed at any time of year. /
23	<i>Boubnit / Membar</i>	Algeria Egypt	Lamb	Salt Spices	Cutting, Seasoning, Cooking	Consumed as appetizer or in sauce. [58]
24	<i>Mkila</i>	Morocco	Beef, Lamb, Goat, Camel	Salt, Spices (coriander, ginger, fresh smashed garlic, pepper, curcumin)	Cutting, Seasoning, Cooking, Frying	Served with tajine. [7, 39]
25	<i>Tehal/Tehane</i>	Morocco	Beef, Lamb, Goat, Camel	Salt, Spices (Coriander, ginger, smashed garlic, hot red pepper)	Seasoning, Stuffing, Cooking	Sliced <i>Tehal</i> can be griddled and served in a sandwich or with cooked rice. [7, 56]
26	<i>Ban-chems</i>	Libya	Beef Lamb	Salt Spices	Cutting, Stuffing, Drying, Cooking	Commonly added as an ingredient in prepared "couscous" or served with pasta. [7, 56]
27	<i>Bouzelouf (Zelif/ Kawareh / H'Rgma)</i>	Algeria Morocco Tunisia Egypt	Beef Lamb	Salt Spices	Cutting, Cooking	Usually consumed during a religious feast "Aid Al Adha" and weddings as a sauce. Sometimes and during winter, as a soup known as <i>Chourbet Kawareh</i> . [58, 93, 97]
28	<i>Klaya</i>	Tunisia	Beef Lamb	Salt, Spices, Olive oil	Cutting, Boiling, Frying	Prepared during Moussems (an annual religious celebration) or weddings. /
29	<i>Bekbouka/ T'qalia / Douara</i>	Algeria, Tunisia, Morocco	Beef Lamb	Salt Spices	Cutting, Cooking	Consumed at any time of year namely soon after "Aid Al Adha". It is also prepared on the eve of weddings by the groom's family. [39]
30	<i>Tangia</i>	Marocco	Beef Lamb	Salt Spices Olive oil	Cutting, Seasoning, Cooking	Prepared for <i>Hammam</i> (steam bath) on Friday and served with a selection steamed and seasonal vegetables as well as bread. [39, 99]
31	<i>Mrouzia</i>	Marocco, Tunisia	Lamb, Beef, Goat	Salt, Spices, Sugar, Honey	Cutting, Seasoning, Cooking	Is mainly prepared after "Aid Al adha" and is consumed with bread [39]
32	<i>Cachir</i>	Algeria	Beef, Lamb, Goat, Camel	Salt, Spices, olives	Grinding, Mixing, Steaming, Cooking	Eaten as an appetizer with salad and used to garnish sandwiches. /

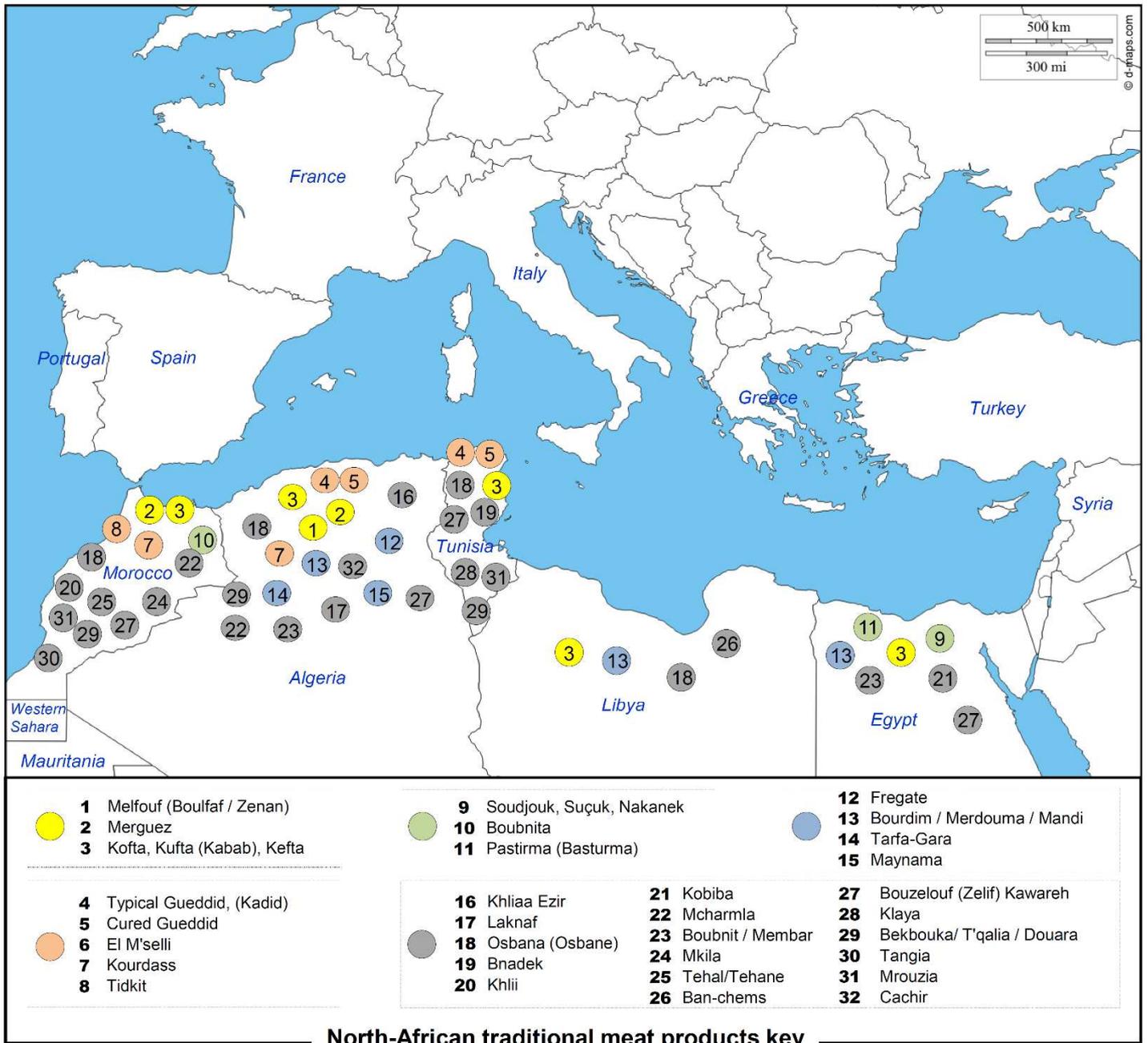


Fig. 1.



***Melfouf / Boulfaf***

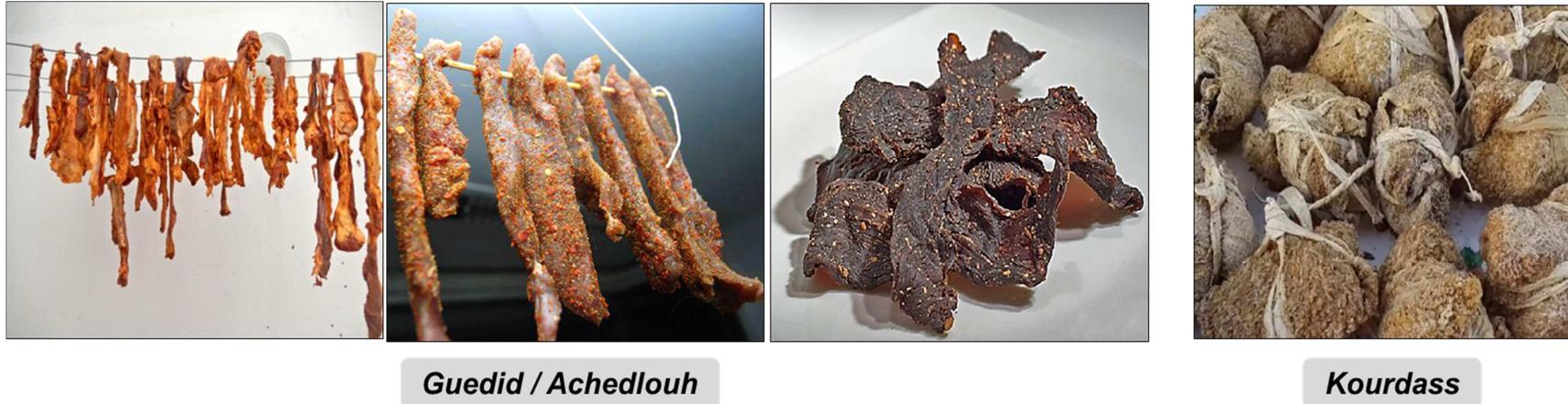


***Merguez***



***Kofta / Kebab / Kefta***

**Fig. 2.**



**Fig. 3.**



**Sucuk / Nakanek**



**Bounnita**



**Pastirma**

**Fig. 4.**

ACCEPTED MANUSCRIPT



***Merdouma / Bourdim***



***Maynama***

**Fig. 5.**

ACCEPTED MANUSCRIPT



Fig. 6.

# Supplementary data

## Ethnic meat products of the North-African and Mediterranean countries: an overview

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**Running title:** Traditional meat products in North Africa

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## Supporting Information

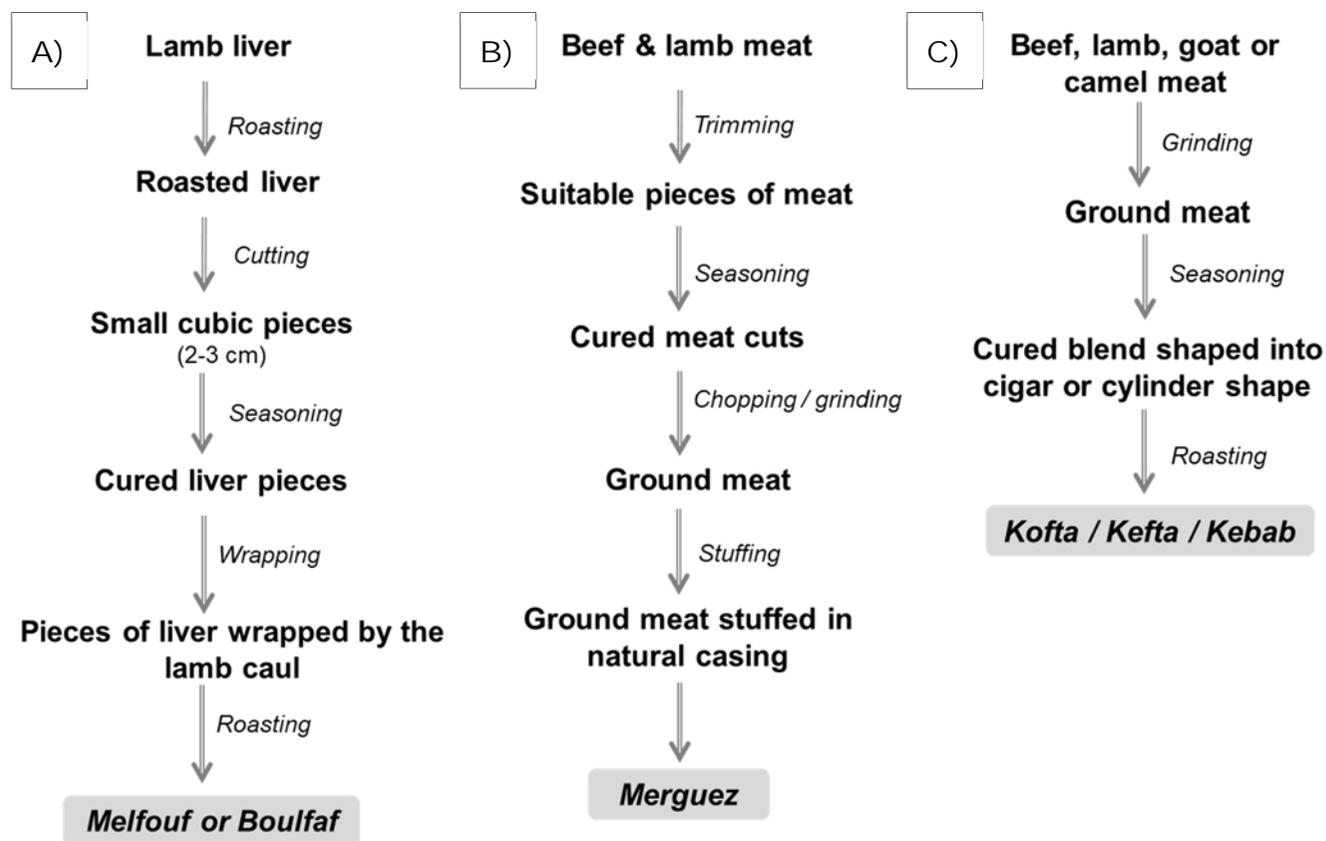
**Supplementary Fig. S1.** Flowchart of the indigenous A) *Melfouf*, B) *Merguez* and C) *Kofta* making. These ethnic North-African meat products are classified in the category I. *Salted and/or marinated meat products but not dried.*

**Supplementary Fig. S2.** Flowchart of the indigenous A) *Guedid*, B) *Cured Guedid*, C) *El messli*, D) *Kourdass* and E) *Tidkit* making. These North-African ethnic meat products are grouped in the category II. *Dried not fermented meat products.*

**Supplementary Fig. S3.** Flowchart of the indigenous A) *Soudjouk/Sucuk/Nakanek*, B) *Boubnita* and C) *Pastirma* making. These North-African ethnic meat products are grouped in the category III. *Fermented semi-dry/dried meat products.*

**Supplementary Fig. S4.** Flowchart of the indigenous A) *Fregate*, B) *Merdouma/Mandi/Bourdim*, C) *Tafra-gara* and D) *Maynama* making. These North-African ethnic meat products are grouped in the category IV. *Smoked meat products.*

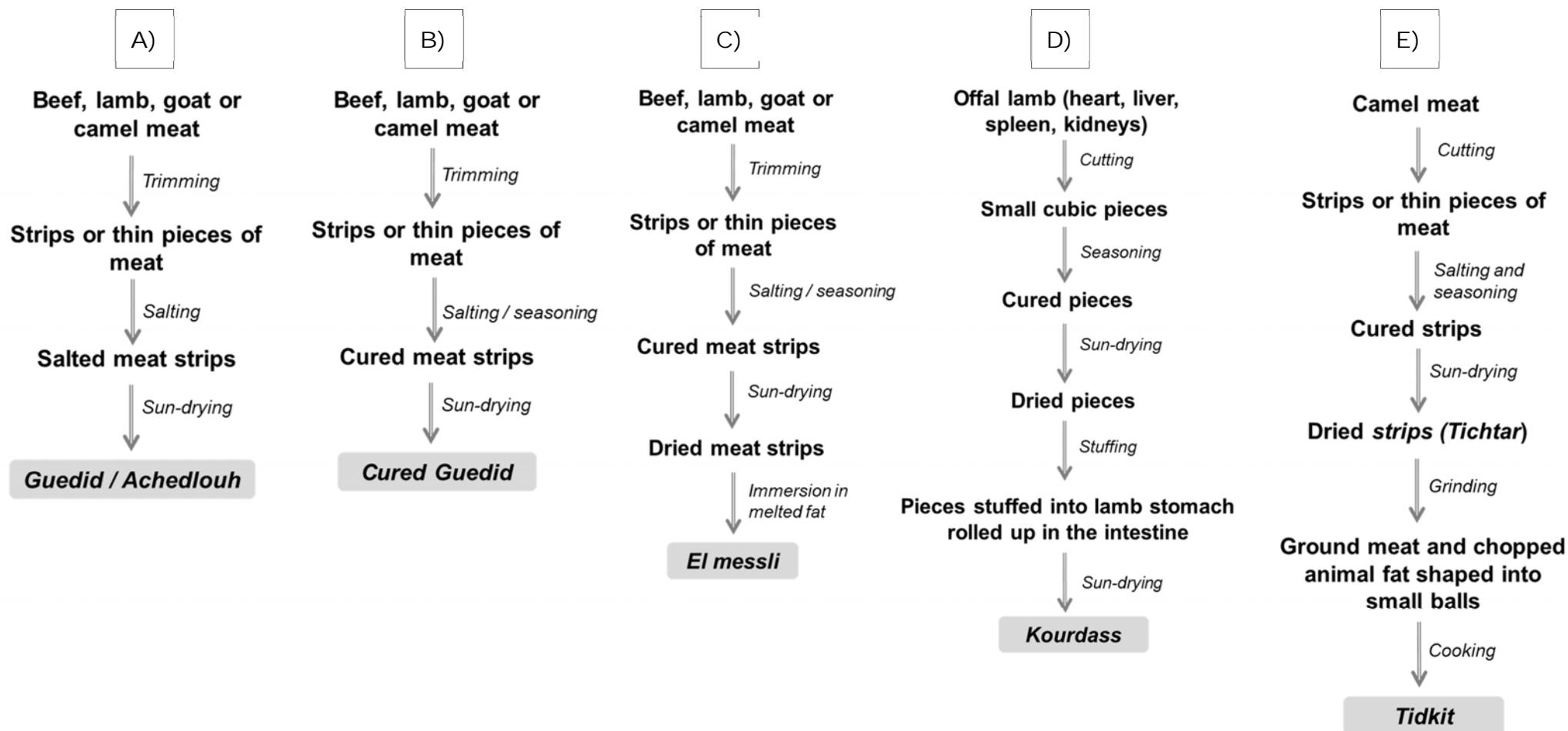
**Supplementary Fig. S5.** Flowchart of the indigenous A) *Khliia Ezir* B) *Laknaf*, C) *Osmana*, D) *Bnadek*, E) Variants of *Khlii*, F) *Kobiba*, G) *Mcharmila*, H) *Boubnita* and *Member*, I) *Mkila*, J) *Tehal/Tehane*, K) *Ban-Chems*, L) *Bouzelouf (Zelif)*, M) *Klaya*, N) *Douara/Bekbouka/T'qalia*, O) *Tangia*, P) *Mrouzia* and Q) *Cachir* making. These North-African ethnic meat products are grouped in the category V. *Cooked and/or candied meat products.*



Supplementary Fig. S1

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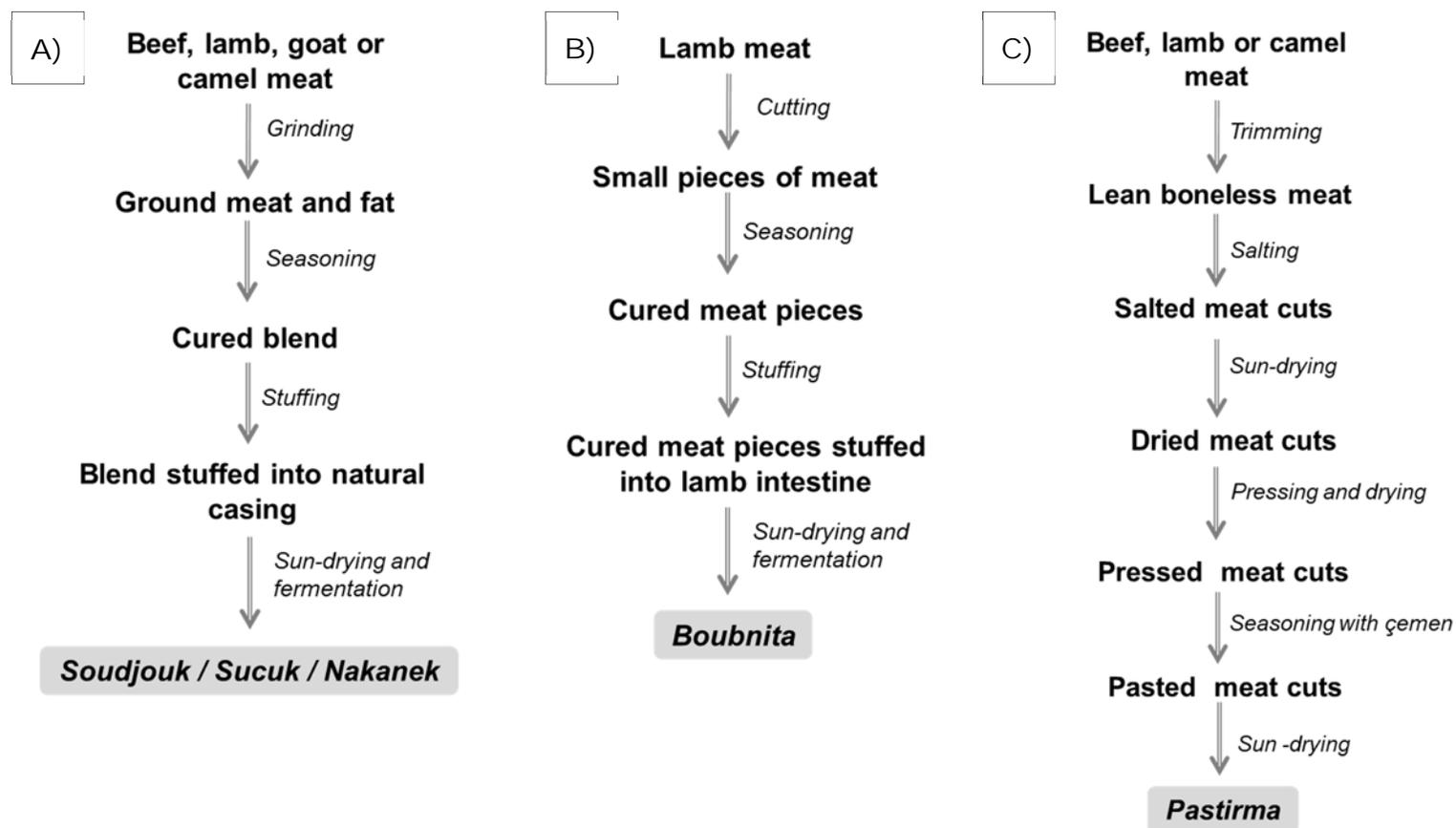
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Supplementary Fig. S2

Comment citer ce document :

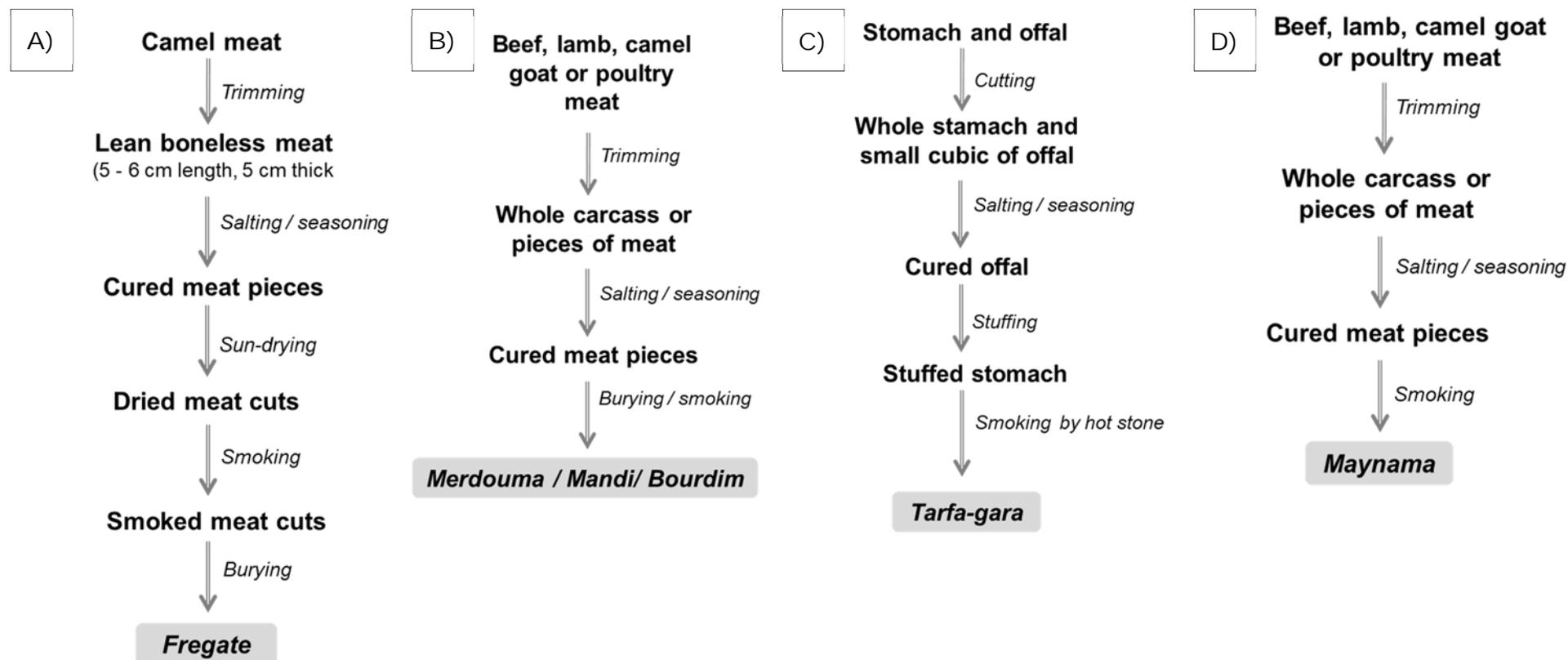
Gagaoua, M., Boudechicha, H.-R. (2018). Ethnic meat products of the North-African and Mediterranean countries: an overview. *Journal of Ethnic Foods.* , DOI : 10.1016/j.jef.2018.02.004



Supplementary Fig. S3

Comment citer ce document :

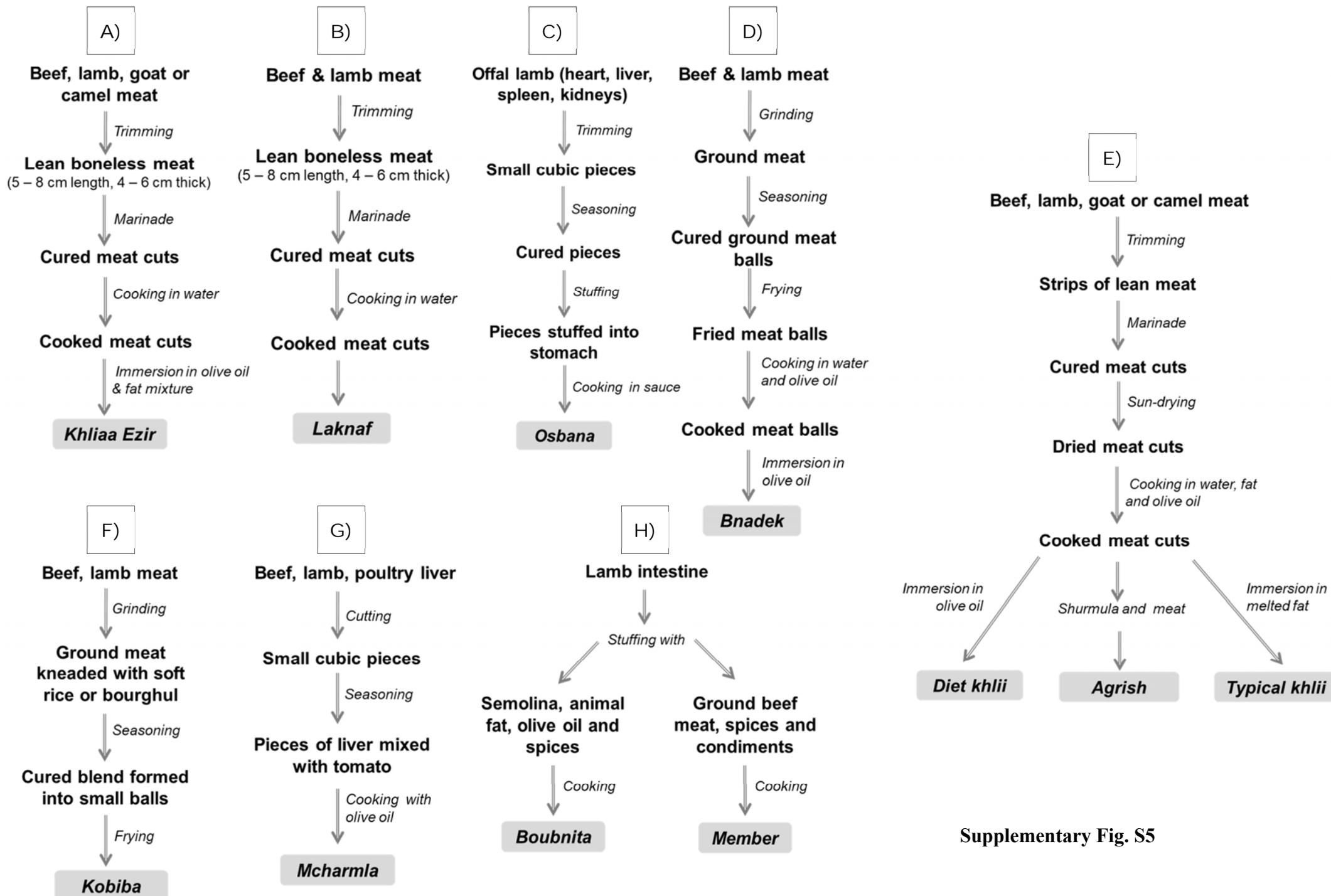
Gagaoua, M., Boudechicha, H.-R. (2018). Ethnic meat products of the North-African and Mediterranean countries: an overview. *Journal of Ethnic Foods.* , DOI : 10.1016/j.jef.2018.02.004



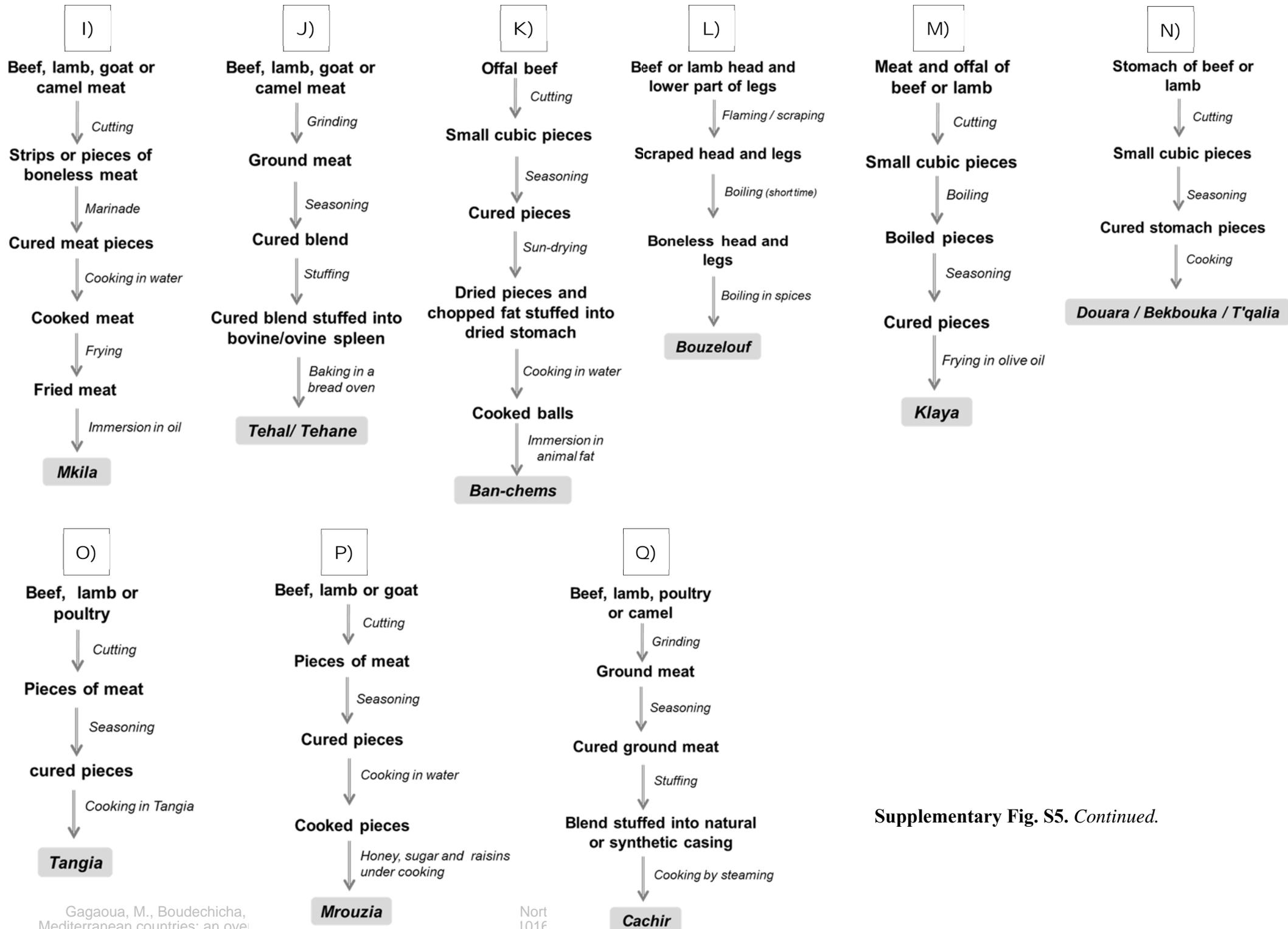
Supplementary Fig. S4

Comment citer ce document :

Gagaoua, M., Boudechicha, H.-R. (2018). Ethnic meat products of the North-African and Mediterranean countries: an overview. *Journal of Ethnic Foods.* , DOI : 10.1016/j.jef.2018.02.004



Supplementary Fig. S5

Supplementary Fig. S5. *Continued.*