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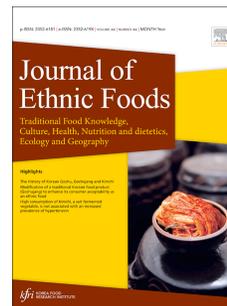
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Ethnic meat products of the North-African and Mediterranean countries: an overview

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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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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 (16th century), Italians, and finally the
136 French and British (18th and 19th 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 (14th - 18th 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 10th 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 cm³ 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 *Kabylian* 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 15th and 16th 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 (± 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. *Osban/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 8th 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 18th and 19th 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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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* (*Suçuk/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
I. Salted and/or marinated meat products but not dried							
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]
II. Dried not fermented meat products							
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		[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	Consumed as a stew/sauce	[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. /

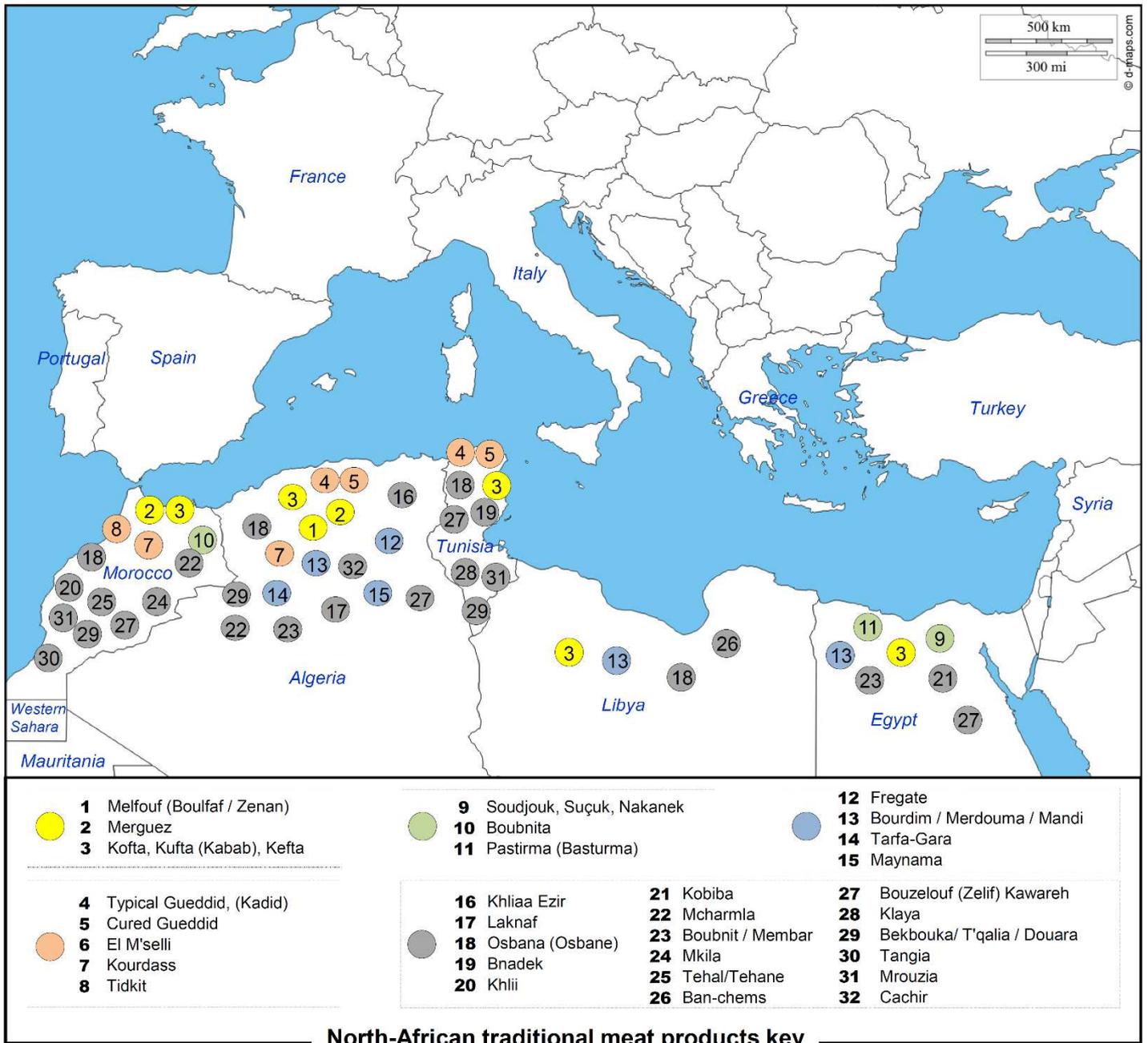


Fig. 1.



Melfouf / Boulfaf



Merguez



Kofta / Kebab / Kefta

Fig. 2.

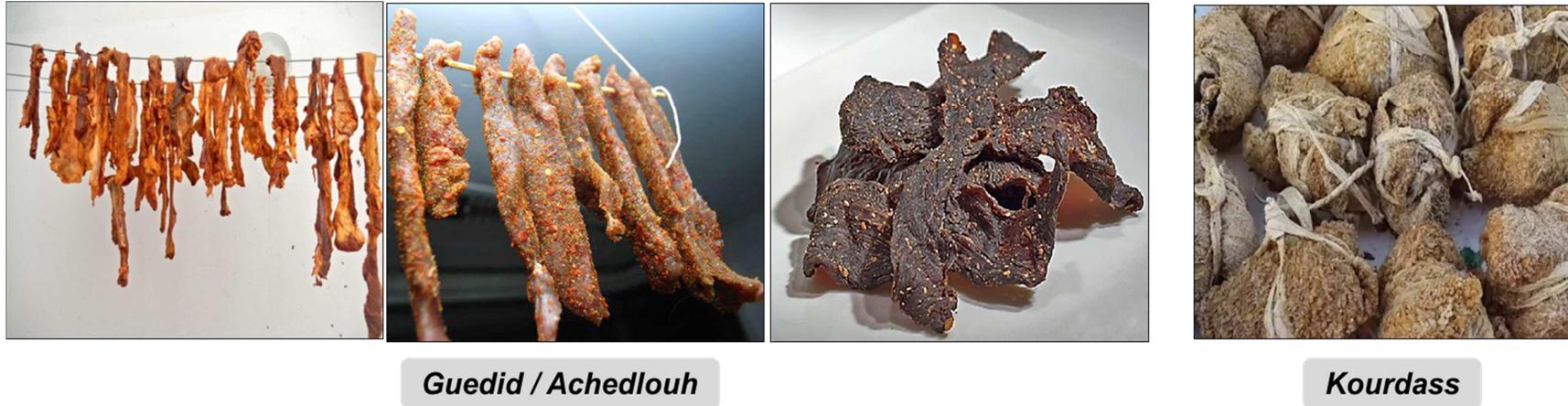


Fig. 3.

**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

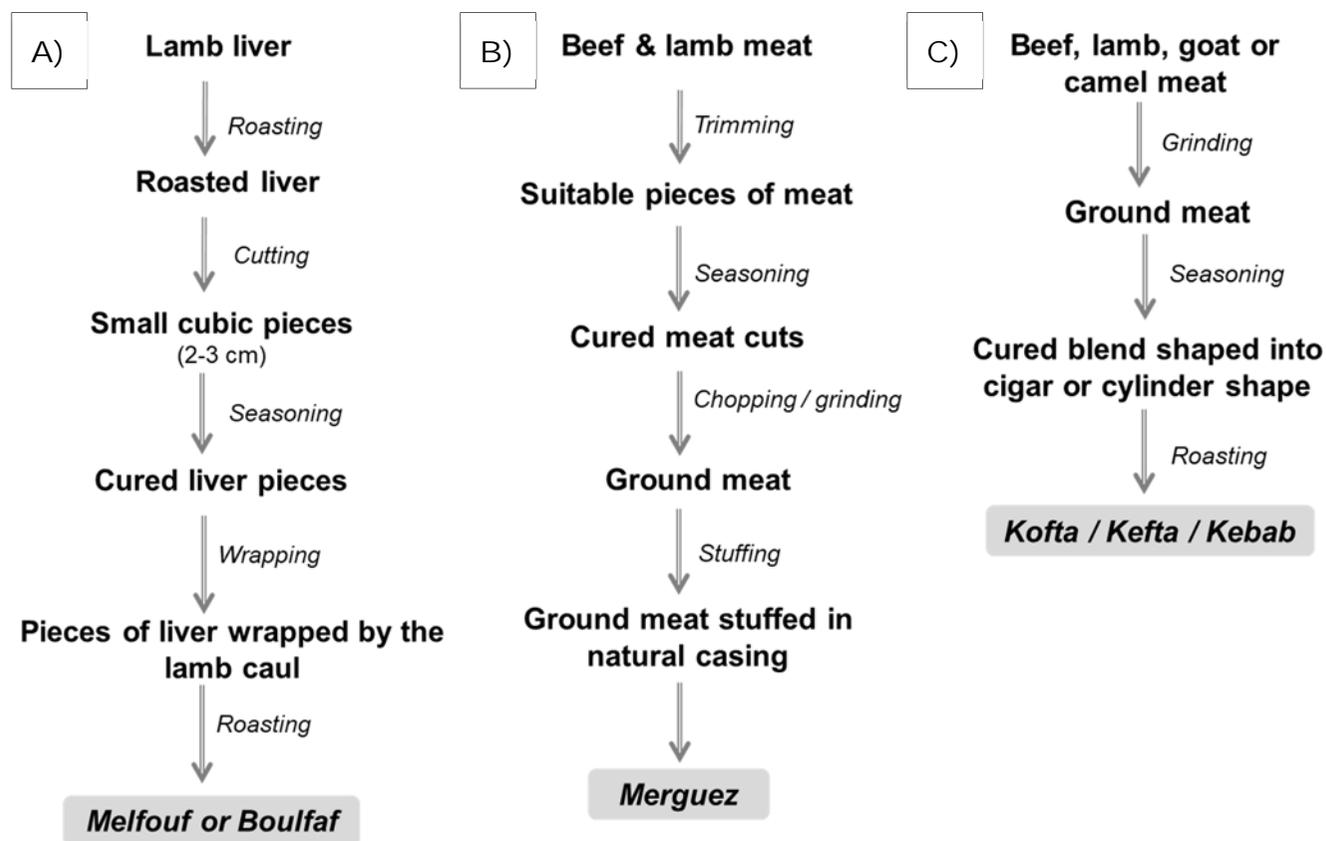
Supplementary Fig. S1. Flowchart of the indigenous A) *Melfouf*, B) *Merguez* and C) *Kofta* making. These ethnic North-African meat products are classified in the category I. *Salted and/or marinated meat products but not dried.*

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.*

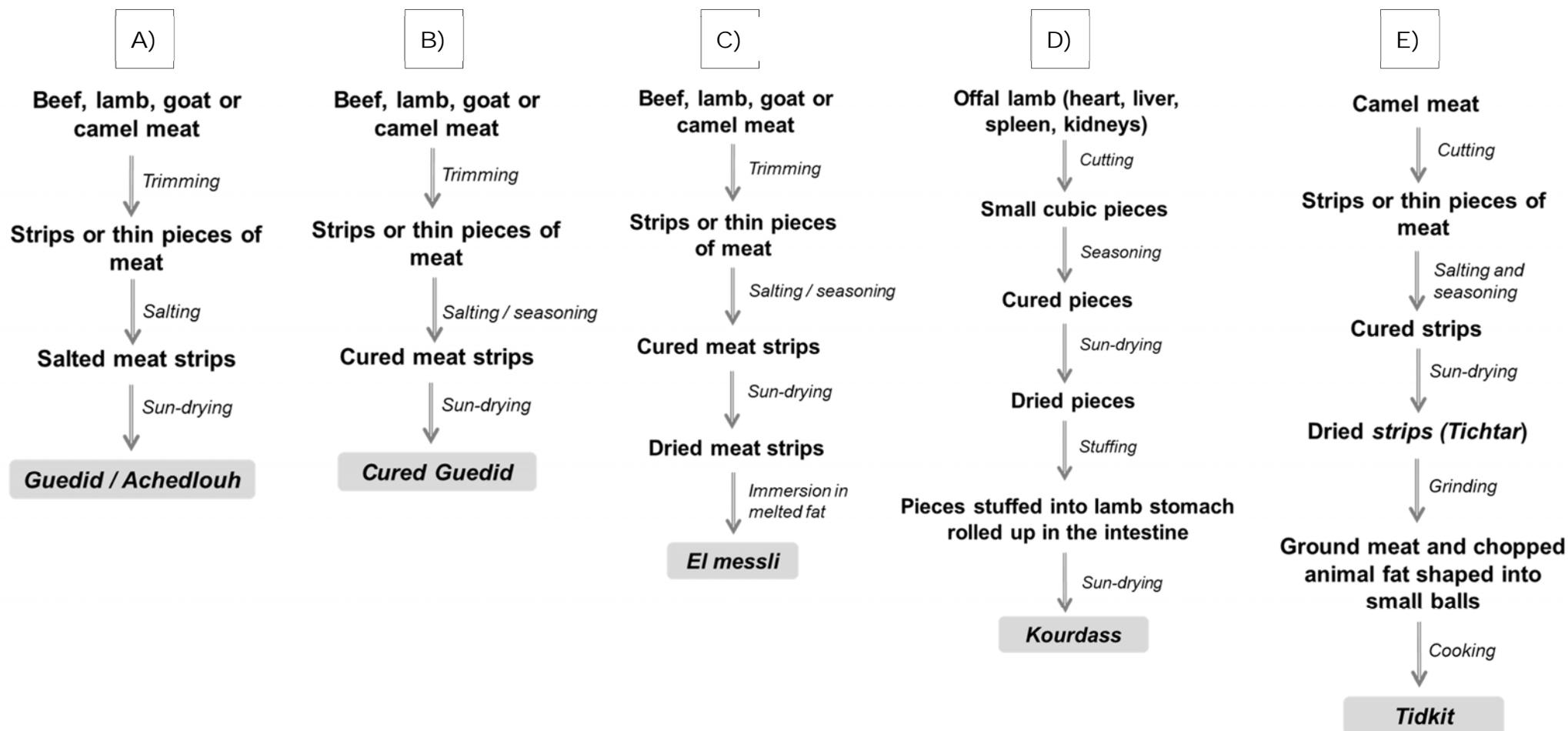
Supplementary Fig. S5. Flowchart of the indigenous A) *Khliia Ezir* B) *Laknaf*, C) *Osmana*, D) *Bnadek*, E) Variants of *Khlii*, F) *Kobiba*, G) *Mcharmila*, H) *Boubnita* and *Member*, I) *Mkila*, J) *Tehal/Tehane*, K) *Ban-Chems*, L) *Bouzelouf (Zelif)*, M) *Klaya*, N) *Douara/Bekbouka/T'qalia*, 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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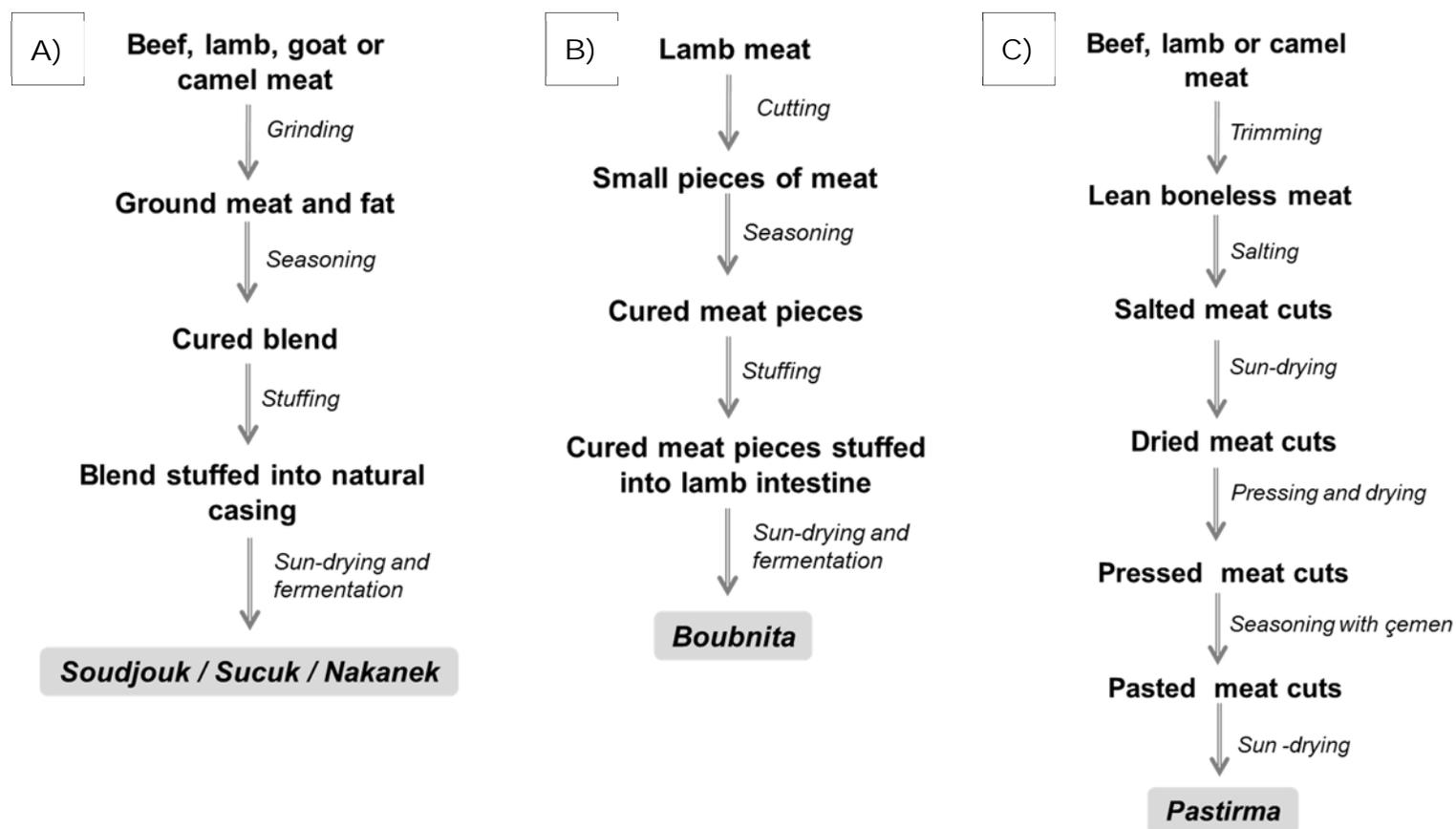
Gagaoua, M., Boudechicha, H.-R. (2018). Ethnic meat products of the North-African and Mediterranean countries: an overview. Journal of Ethnic Foods. , DOI : 10.1016/j.jef.2018.02.004



Supplementary Fig. S2

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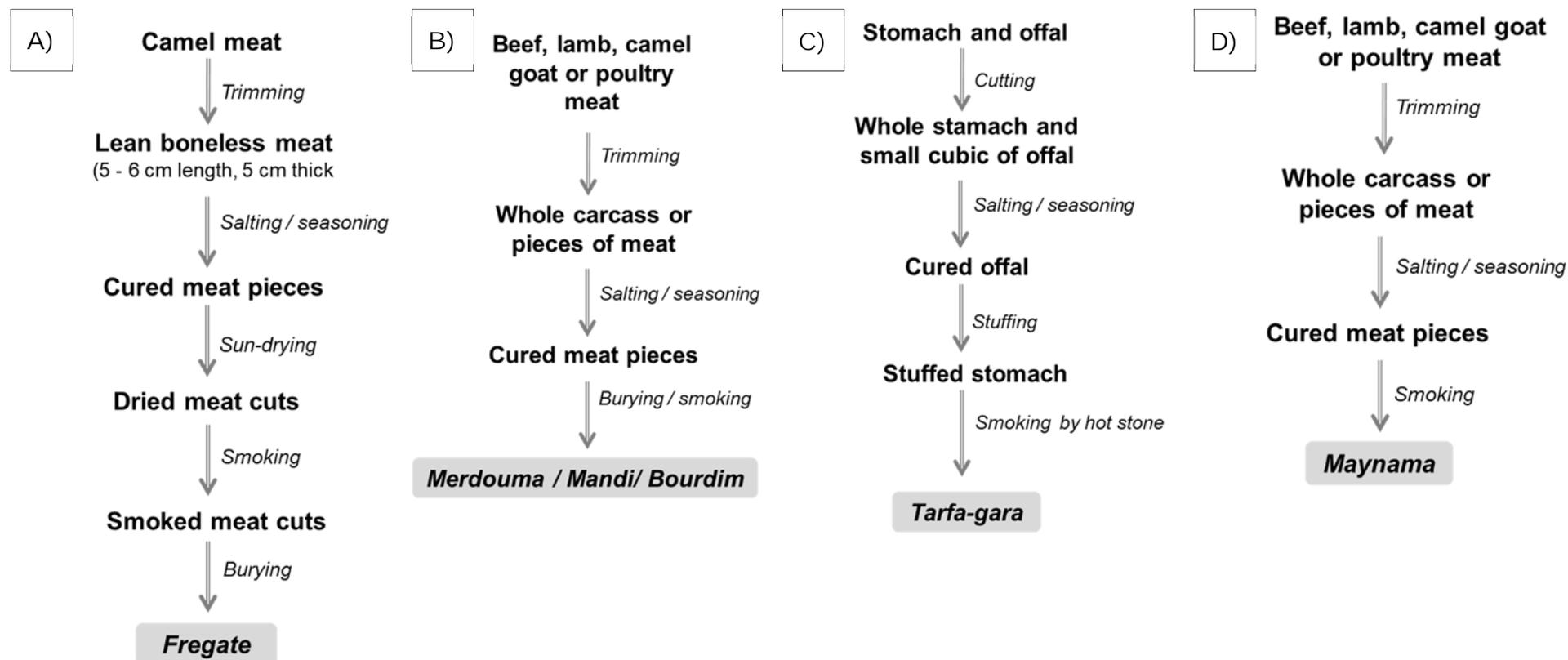
Gagaoua, M., Boudechicha, H.-R. (2018). Ethnic meat products of the North-African and Mediterranean countries: an overview. *Journal of Ethnic Foods.* , DOI : 10.1016/j.jef.2018.02.004



Supplementary Fig. S3

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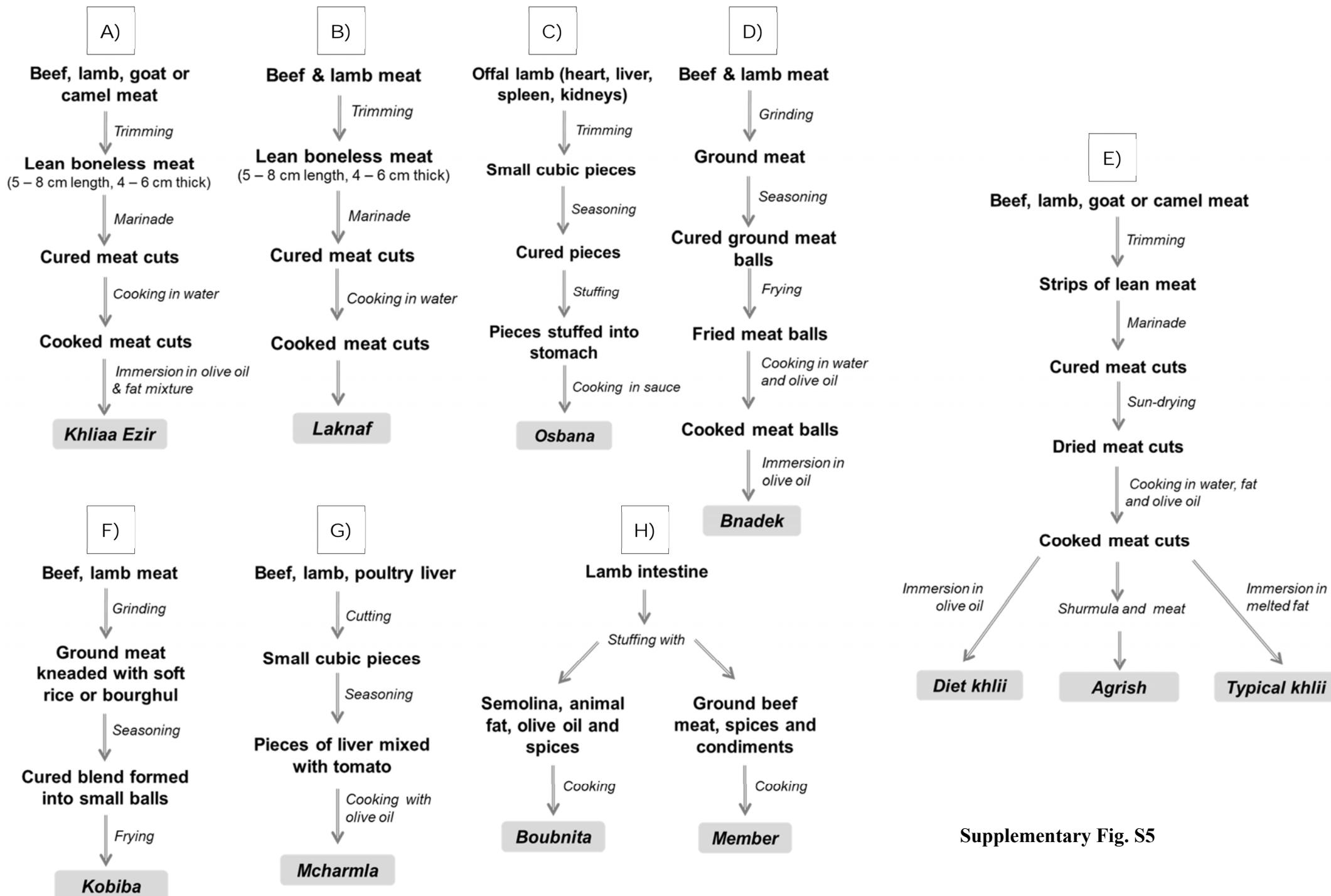
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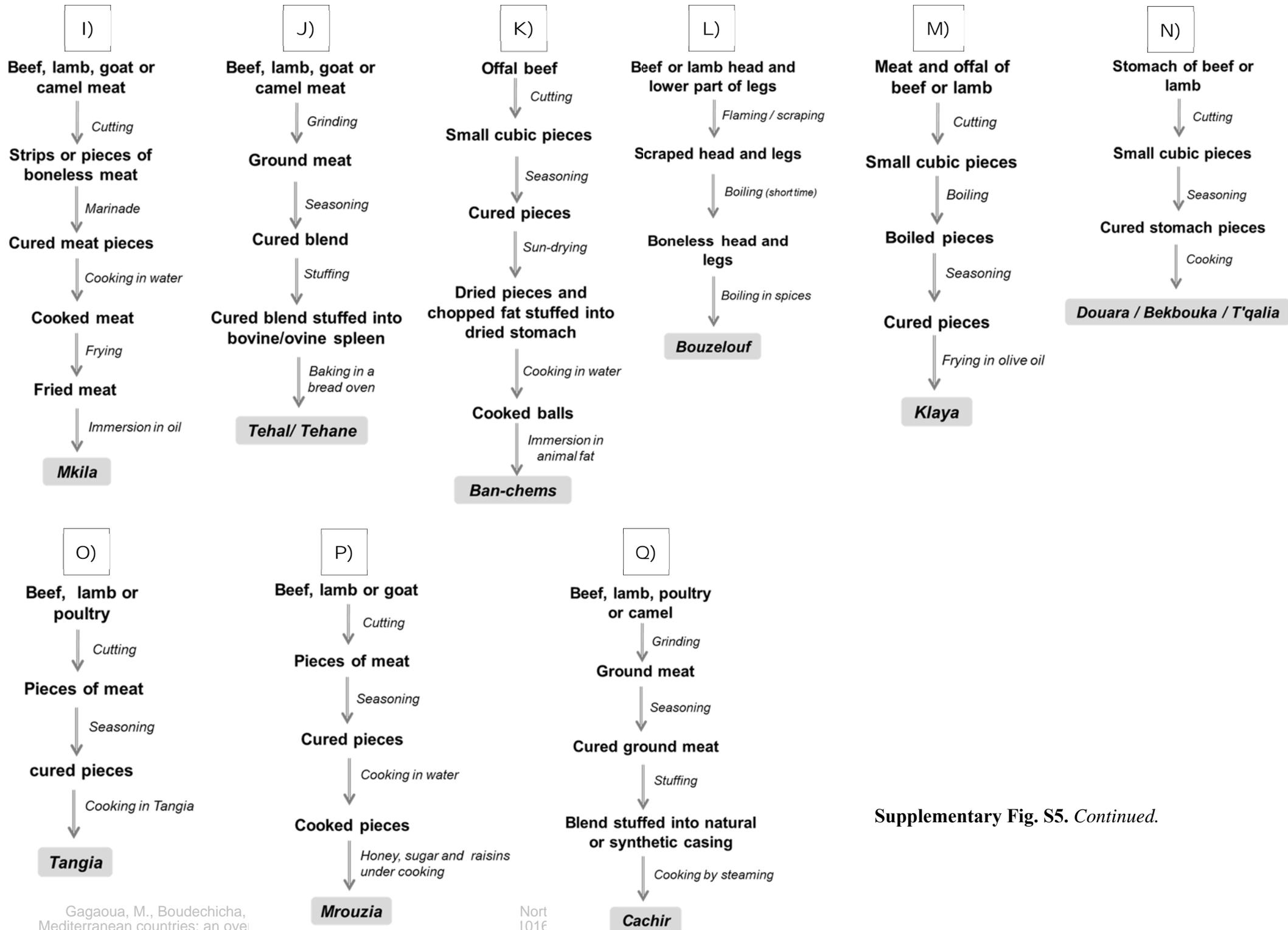
Supplementary Fig. S4

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Supplementary Fig. S5

Supplementary Fig. S5. *Continued.*