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2 **Fermented meats (and the symptomatic case of the Flemish food pyramid):**
3 **are we heading towards the vilification of a valuable food group?**

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29 Fermented meats (*i.e.*, salami, saucisson sec, chorizo, fuet, etc.) have been extremely precious to
30 humans for millennia, constituting a cultural heritage and category of foods that are not only
31 exceptional with respect to their sensorial aspects and nutrient density (*i.e.*, protein, fat, vitamins,
32 iron, zinc, etc.), but also because of their stability and convenience (Leroy et al., 2013, 2015). They
33 are generally prepared as sausages, by stuffing a meat batter consisting of mince, fat, curing salt,
34 herbs, and spices into casings to exclude oxygen and initiate a microbial fermentation process,
35 followed by drying and maturation. Optionally, smoking or moulding can be applied. The curing salt
36 habitually contains nitrate, already applied since Roman times as salt peter, to create an appealing
37 red colour and to generate additional food safety. Contemporary variants may also contain
38 ascorbate and sometimes nitrite (besides or instead of nitrate), as well as some technological
39 additives that are not strictly necessary but may reduce cost in products at the lower value end (*e.g.*,
40 baking agents, colorants, texturizers, ...) Within the larger category of processed meats (*e.g.*, hot
41 dogs, canned meat, meat-based sauces, and bacon), fermented meats nevertheless represent a
42 stronghold for healthy products of outstanding quality, for which production relies on the long-
43 standing and mild empiric preservation methods of salting, fermentation, and drying. In the last
44 couple of decennia, however, their positive image is increasingly under attack, often driven by
45 ideological or economic agendas instead of solid scientific approaches. This evolution leads to
46 confusing amalgams of factual observations with more emotive elements that have little to do with
47 the actual topic of discussion (*i.e.*, the evidence-based analysis of the nutritional significance of
48 fermented meats in healthy and varied diets). For instance, negative views on meat are often
49 confounded with repugnance of animal killing or other non-nutritional issues (Leroy & Praet, 2017).

50 As an *ad hoc* collective of food scientists, technologists, and microbiologists, we wish to stress the
51 need for further studies on this matter and to advance five arguments in favour of the inclusion of
52 fermented meats in the diet rather than their elimination based on questionable grounds. Convinced
53 of the unmatched and undoubtedly proven values of fermented meats, we argue that their
54 condemnation by certain nutritional models (1) is inconsistent and logically flawed and (2)

55 overstates potentially negative effects, whereas their strengths rely in their contribution to (3) the
56 prevention of certain nutrient deficiencies, (4) the health-stimulating increase of microbial diversity
57 in the gut, and (5) gastronomic legacy.

58 Regrettably, fermented meats are often negatively linked to issues of sustainability, degree of
59 processing, and potential high contents of (curing) salt, sugar, and fat. Although true for some
60 products, these aspects are certainly not to be generalized to the entire group. Moreover, they are
61 equally applicable to several other food items that are more beneficially looked upon (Walker et al.,
62 2010), which results in inconsistent and incoherent advice. As an example, a new food pyramid was
63 published in Flanders, Belgium, on September 19, 2017, with a strong focus on plant foods as well as
64 the advice to eat less red meat and to ban every type of processed meat from the human diet
65 without differentiation, for instance including bacon but also dry-cured and fermented meat
66 products (Vlaams Instituut Gezond Leven, 2017; *i.e.*, a partner organisation of the Flemish
67 authorities, mandated as expertise centre for health promotion and commissioned to develop a food
68 pyramid). As such, the latter have been put on the same level as crisps, candies, and alcoholic
69 beverages. Although some existing food guides already advised to moderate or limit (“eat less”) the
70 consumption of processed meats (Food and Agricultural Organization, 2018), the message now
71 clearly aims at avoidance (“eat as little *as possible*”), setting the limits even more strictly. About a
72 month after its release, the Flemish food pyramid was heavily criticized by Harcombe (2017) as a
73 *belief system*, which advances for instance that red meat, saturated fat, and processing are “bad”,
74 rather than using an evidence-based nutritional approach. Meat analogues, for instance, are often
75 ultra-processed foods with excessive amounts of salt and additives (Testaankoop, 2013), whereas
76 several hyped plant foods are currently posing major environmental concerns (The Telegraph, 2016).
77 Moreover, the approach whereby entire food groups are stigmatized without differentiation or any
78 form of nuance is overly reductionist. It is scientifically unacceptable to reduce the vast variability of
79 fermented meats into a single monolithic category. Potential health effects may not be the same for
80 all products (Oostindjer et al., 2014). Indeed, existing products vary widely with respect to meat

81 type, fat content, salt concentration, addition of sugar, nitrate or nitrite levels, use of additives, and
82 degree of processing (Toldrá, 2014). The fact that some of these ingredients have sensory,
83 technological, and especially hygienic safety advantages is mostly neglected, whereas their potential
84 negative impacts are overstated. For instance, nitrate in fermented meats leads to colour and
85 flavour development as well as enhanced food safety, while these fractions are very small compared
86 to the intake through drinking water or vegetables (DFG, 2014). Besides, it is important to point out
87 that there is no objective reason to equate processing *de facto* with non-healthiness (Gibney et al.,
88 2017). The word “processing” is defined by the Oxford dictionary as to “perform a series of
89 mechanical or chemical operations on (something) in order to change or preserve it” (Anonymous,
90 2017). Although some specific aspects of food processing may indeed be detrimental to health, for
91 example by generating *trans* fatty acids or reducing the micronutrient availability (Cornwell et al.,
92 2018; King & White, 1999), which mostly are of little concern in the case of fermented meats. Other
93 processing steps are harmless or may even be beneficial, for instance to allow for preservation or to
94 enhance the bioavailability of micronutrients or other beneficial compounds (Ríbas-Augusti et al.,
95 2017; Weaver et al., 2014). Binary oppositions as “processed/natural”, of which one term is more
96 highly valued than the other, have been exposed by post-structural theory as mere cultural
97 constructs rather than foundational categories we can confidently rely on (Belsey, 2002). The related
98 division of fermented meats in the binary opposition “traditional/innovative” has been
99 deconstructed previously on similar grounds (Leroy et al., 2015). Such binary conceptions easily lead
100 to misleading and fuzzy ideas about what is “natural”, “traditional”, “processed”, or - for that matter -
101 “healthy” when they go unquestioned. Because meaning is incorrectly seen as referential rather
102 than differential, a whole spectrum of differently processed meats has been unrightfully lumped into
103 a single category.

104 Although epidemiological data have linked the consumption of red meat and processed meat to
105 cardiometabolic diseases and colon cancer (Bouvard et al., 2005; Micha et al., 2017), this line of
106 thought has been heavily questioned and needs to be seen in proper perspective. In this respect, it

107 has been pointed out that the relative risks are very small and that these studies can impossibly
108 correct for all associated life-style factors, neglect the effect of inclusion in wholesome diets, mostly
109 use “processed meats” as an undifferentiated category, and fail to convincingly show causality
110 (Klurfeld, 2015; McNeill, 2014; McNeill & Van Elswyk, 2012). Bastide et al. (2016) have demonstrated
111 that a global assessment of diets, rather than of single foods such as meat and its specific
112 components, is needed for proper nutritional prevention of colorectal carcinogenesis. Indeed, intake
113 of other dietary compounds, such as calcium carbonate, α -tocopherol, and chlorophyll from green
114 vegetables, were shown to counteract carcinogenicity and cytotoxic outcomes of diets containing
115 (cured) meat (de Vogel et al., 2005; Pierre et al., 2013). All-too simplistic approaches based on mere
116 hazard identification and classification for carcinogenicity, which have been placing products with
117 widely divergent modes of action and potencies into the same category, are increasingly being
118 criticized as detrimental for both science and society (Boobis et al., 2016). It is primordial to point
119 out that the classification of processed meats as carcinogenic by the International Agency for
120 Research on Cancer (2015) is a hazard-based approach, which should not be mistaken for risk, the
121 latter being based on the likelihood and level of exposure for different population groups at certain
122 consumption levels. Based on the available evidence, the European Food Safety Authority (2017)
123 concluded that existing safety levels for nitrites and nitrates added to meat and other foods are
124 sufficiently protective for consumers. Such confusion can indeed lead to a range of perilous
125 outcomes, namely the generation of public confusion and anxiety, the subjection of useful foods
126 with a safe history of use to excessive scrutiny, the subsequent risk on replacement by less
127 characterized and potentially unsafe alternatives, the unnecessary hypothecating of valuable public
128 resources, and the diversion of attention from more substantial nutritional problems. Finally,
129 intervention studies that convincingly prove that the inclusion of normal, non-excessive portions of
130 fermented meats within healthy diets are harmful are currently missing (Turner & Loyd, 2017).

131 Explicitly communicating that fermented meats are harmful may have several important negative
132 consequences on human health. It is nothing less than a dangerous social experiment to steer

133 towards the replacement of nutrient-rich foods that have a long tradition within a given food
134 culture. Flemish households, for instance, lack the culinary feel with the leguminous meals that are
135 common in the Mediterranean and are mostly alien to so-called meat analogues (*e.g.*, mycoproteins,
136 tofu, and tempeh). We can only speculate on which alternative dietary approaches will be followed,
137 especially in the lower socio-economic classes, as nutritional guidelines often overlook the resources
138 and consumption culture of ordinary families (Gibney et al., 2017). Approaches thus tend to be
139 fundamentally elitarian, whereby only people with the required level of education, nutritional and
140 culinary knowledge, and budget can venture safely into such substitutions, whereas most are still
141 relying on fermented meats as an easy and common option to introduce “difficult” nutrients in their
142 diets and that of their children. This is particularly true for the necessary intake of protein, iron, zinc,
143 and B vitamins. Fermented meats are not only compatible with Flemish food traditions and taste,
144 they also are affordable and show an exceptional level of convenience (Leroy & Degreef, 2015). It
145 will have to be evaluated how their substitution will, for instance, affect protein malnutrition (*e.g.*, in
146 infants and elderly) and anaemia (*e.g.*, in young females). Whereas some population segments are
147 already known to develop malnutrition due to meat-avoidance (Waldmann et al., 2004), the
148 inclusion of animal-source snacks can effectively improve micronutrient intake in vulnerable
149 populations (Hall et al., 2017).

150 Repercussions on health may also be expected on the level of gut health, when fermented meats are
151 considered from a metagenomic point of view (Dutton & Turnbaugh, 2012). They are part of the
152 larger food group of fermented foods, for which it has been claimed that regular consumption
153 improves health (Bell et al., 2017; Chilton et al., 2015; Marco et al., 2016), whereas deprivation may
154 even potentially lead to higher risks on disease (Olivares et al., 2016). Fermented meats harbour a
155 variety of living microorganisms, including lactic acid bacteria, coagulase-negative staphylococci,
156 yeasts, and moulds (Toldrá, 2014), of which the lactic acid bacteria in particular are often cited with
157 respect to possible health advantages (De Vuyst et al., 2008; Douillard & de Vos, 2010). As it has
158 been demonstrated that meat-associated microorganisms can indeed be detected within the

159 intestinal microbiome (Dal Bello et al., 2003; David et al., 2014; Walter et al., 2001), they are
160 expected to play a role in the overall gut microbial biodiversity and, hence, the health of the host.
161 Advocating against their consumption is thus in stark contradiction with nutritional advice to
162 increase the consumption of fermented foods.

163 Finally, the production and consumption of fermented meats go back to Antiquity at least, although
164 much older origins may be hypothesized, and they have remained valuable ever since (Leroy et al.,
165 2013). Fermented meats are therefore an important part of our cultural patrimony. This is especially
166 the case in Europe, where they often have strong connotations of local distinctiveness and artisan
167 pride (Leroy et al., 2015). In other words, food is more than just a biochemical collection of fuel and
168 nutrients, a vision that is all too often leading to damaging medicalization discourses (Fischler, 2013;
169 Lecerf, 2015). Instead, food constitutes a profound part of our identity and cultural heritage
170 (Bellasco, 2008), which holds particularly true for meat and its derived products (Leroy & Praet,
171 2015) estimated as being among the most precious parts of the human diet. It should be respected
172 and enjoyed as such.

173 To conclude, we regret that fermented meat products are being incorrectly stigmatised as unhealthy
174 foods in certain nutritional models, whereas they have many nutritional and other benefits to offer.
175 Even within the context of sustainability, it should be considered that they often serve to valorise
176 less-desired carcass parts, do not require strong cooling, have a high shelf-life stability, and are
177 mostly eaten raw without heating. An appropriate message to the public should be that a varied and
178 moderate daily diet, of which fermented meat products are a part, is the best for human health, as
179 too much of anything is always bad. Together with other fermented foods they form a quantitatively
180 balanced part and at the same time represent a true treasure in human nutrition.

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