Pig meat-health: a possible binomial?

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SUMMARY

Meat and meat products are important sources of essential nutrients for humans, but recent epidemiological studies have associated red meat and processed meat consumption with an increased risk of cardiovascular disease and colorectal cancer due to saturated fatty acids, added salt, oxidative products, N-Nitroso compounds that develop during processing steps, and oxidative capacity of HEME-Iron. Moreover, the International Agency for Research on Cancer has recently defined red meat as probably carcinogenic and cured meat as carcinogenic. This has created considerable alarm among consumers, a significant reduction in consumption of these products and a remarkable negative impact on the market. Europe, with about 150 million of pigs and a yearly production of about 22 million tons carcass weight, is the second biggest producer of pork in the world, and the Mediterranean area of Europe is known around the world for the high quality of processed pig meat products. Therefore, it seems very important to develop new strategies of production and processing that can improve the healthful features of pork and derived products. The paper focuses on some of these strategies.

INTRODUCTION

Meat and meat products have a high nutritional value due to their good levels of protein content (20-35%) providing all essential well balanced amino acids, of fat solubles (A, D, E, K) and B6 and B12 vitamins, of long chain n-3 polyunsaturated fatty acid (PUFA), readily absorbable iron, selenium, zinc (Mourouti et al., 2015) and, especially in ruminant meat, an appreciable conjugated linoleic acid (CLA) level (Chin et al. 1992). For long time meat consumption has been positively associated with human health, but in the recent years it is frequently associated with a negative health image and a low meat intake, especially red and processed meat, is recommended to reduce the risk of cancer and metabolic syndrome (Biesalski, 2005; WCRF/AIRC,
2009). Nevertheless, due to the rapid economic development, in the last decades the consumption of meat in Europe has gradually increased (Table I) and therefore it is necessary adopt strategies to improve quality of meat and meat products making them healthier for consumers. Indeed, one of the key goals of nutritional research focuses on the modification of fatty acid composition of meat and on the improvement of the oxidative stability of lipids.

MEAT AND HEALTH

Since meat and meat products are important sources of essential nutrients for humans and also a major source of fat in the diet, there is an increasing interest in modifying the fatty acid (FA) composition of meat lipids in order to improve nutritional value of meat (Enser et al. 2000).

Diets high in saturated fatty acid (SFA) contribute to increase LDL-cholesterol level, which is positively related to the occurrence of heart diseases (Nieto & Ros, 2012) and it has been hypothesized to increase the risk of colorectal cancer (CRC) (Lin et al. 2004). In the last few decades several epidemiological studies have associated red meat and processed meat consumption with an increased risk of cardiovascular diseases (CVD) (Kontogianni et al. 2008) and CRC (Cross et al. 2007). Mechanisms by which meat and meat components could promote the cancer were investigated by meta-analyses (Larsson & Wolk, 2006) and the main hypothesized mechanisms involve the excess of fat, protein and iron (Corpet, 2011). In particular, different works have confirmed that Heme-Iron content and nitroso compounds are the most relevant causes of CVD and CRC, because are the major responsible for fat peroxidation and N-nitroso pathway, the latter mostly in cured meat (Pierre et al. 2006). Moreover, type, time and temperature of cooking can generate polycyclic aromatic hydrocarbons and heterocyclic amines which are carcinogens (Sugimura et al. 2004).

To reduce the risk of cancer due to the red meat and processed meat consumption, the World Center Research Fund (WCRF) and the American Institute for Cancer Research (AIARC) recommended in 2009 that “red meat intake should be no more than 500 g/week and avoid processed meat” (WCRF/AIARC, 2009). Besides, in 2015 the International Agency for Research on Cancer (IARC) has classified consumption of processed meat as “carcinogenic to humans” (Group 1) and red meat as “probably carcinogenic to humans” (Group 2A) (Bouvard et al. 2015). However, it is important to notice that the real average daily intake (g/d) of total meat (Figure 1) (McAfee et al. 2010) showed wide differences among countries with a US consumption almost double with respect to the average in the European countries.

Nevertheless, the definition of “red meat” is inconsistent within the scientific community. In European cohort studies, “red meat” is defined as fresh-meat from four-legged and domestic animal, while in some of the American cohort studies, “red meat” includes processed meat (DTU Food, 2016). However, processed meat products may include also preservatives as nitrate/nitrite, salt, sugar, and probably the different typologies of preservation contribute to increase the probability of the risk for human health. Indeed, in American studies, the association between CRC and meat intake resulted more pronounced compared to European ones (DTU Food, 2016). A different approach to define the “red meat” implies instead the amount of total Heme in meat and according to this definition, raw pork would be closer to rabbit or chicken meat, commonly considered as white meat, than to beef meat (Table II). Therefore, it is necessary to define more precisely what is meant by “red meat” in order to draw correct hypothesis about the red meat cancer risk.

SOME STRATEGIES TO IMPROVE PIG MEAT QUALITY

Recently, the quality is becoming an important issue for consumers. Their main concerns relatively to pig meat are the content of fat, saturated fatty acids (SFA) and cholesterol. Therefore, it seems very important to develop new strategies of production and processing that can improve the healthful features of pork and derived products. Some of these strategies involve genetic and nutritional tools to modify the composition of the carcass and tissues as the reduction of fat depots, SFA and cholesterol, the increment of monounsaturated fatty acids (MUFA),

Table I. Evolution of meat supply in Europe (Kg per capita by year, FAO, 2016) (Evolución del consumo di carne in Europa (Kg pro capite per anno).

<table>
<thead>
<tr>
<th>Year</th>
<th>Total meat</th>
<th>Pork</th>
<th>Beef</th>
<th>Poultry</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>64.8</td>
<td>28.5</td>
<td>21.4</td>
<td>9.2</td>
</tr>
<tr>
<td>1980</td>
<td>80.3</td>
<td>38.5</td>
<td>22.1</td>
<td>13.8</td>
</tr>
<tr>
<td>1990</td>
<td>85.0</td>
<td>41.2</td>
<td>21.5</td>
<td>16.5</td>
</tr>
<tr>
<td>2000</td>
<td>84.0</td>
<td>41.5</td>
<td>16.2</td>
<td>19.6</td>
</tr>
<tr>
<td>2010</td>
<td>83.4</td>
<td>40.9</td>
<td>16.2</td>
<td>21.9</td>
</tr>
<tr>
<td>1970-2010 variation (%)</td>
<td>+ 28.7</td>
<td>+ 43.4</td>
<td>- 24.3</td>
<td>+ 138</td>
</tr>
</tbody>
</table>

Figure 1. Average daily intake of total meat in different countries. Real average daily intake measured by the European Prospective Investigation into Cancer and Nutrition, EPIC study (Wyness et al., 2011, modified) (Consumo medio giornaliero di carne in differenti paesi. Il reale consumo medio giornaliero è stato calcolato da uno studio dell’European Prospective Investigation into Cancer and Nutrition (EPIC)).
**Table II. Total and Heme Iron content of raw meat (Lombardi-Boccia et al. 2002, modified) (Contenuto totale di ferro e di ferro-EME della carne cruda).**

<table>
<thead>
<tr>
<th>Species</th>
<th>Total iron (mg/100g)</th>
<th>Heme iron (mg/100g)</th>
<th>Heme iron (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lamb</td>
<td>2.23</td>
<td>1.68</td>
<td>75.3</td>
</tr>
<tr>
<td>Horse</td>
<td>2.21</td>
<td>1.75</td>
<td>79.2</td>
</tr>
<tr>
<td>Beef</td>
<td>2.09</td>
<td>1.82</td>
<td>87.1</td>
</tr>
<tr>
<td>Chicken</td>
<td>0.59</td>
<td>0.22</td>
<td>37.3</td>
</tr>
<tr>
<td>Rabbit</td>
<td>0.45</td>
<td>0.25</td>
<td>55.6</td>
</tr>
<tr>
<td>Pork</td>
<td>0.42</td>
<td>0.26</td>
<td>61.9</td>
</tr>
</tbody>
</table>

**Figure 2. Backfat thickness variation in Italian heavy pig between 1965 and 2010.**

**CONCLUSIONS**

On the basis of the available data, the association between cancer risk and consumption of red and processed meat is convincing even if the mechanisms involved are still not completely clarified. For example, the hypothesis about the red meat cancer risk depends on the definition of “red meat”, which remain questionable. In the last decades, an increased general consumer awareness of this problem resulted in a raised demand of healthier meat and meat products: on the one hand the reduction of fat, cholesterol, sodium and nitrite and on the other hand an improved of FA composition.

Regarding the FA composition in pork meat, it is easily and directly influenced by diet. Nowadays, the pig dietary supplementation with the n-3 PUFA, protecting them from peroxidation by complementary supplementation with vitamin E or others natural antioxidants, results in a pig meat that fit with human nutritional needs.
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