Italian consumers standing at the crossroads of alternative protein sources: Cultivated meat, insect-based and novel plant-based foods

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1. Introduction

It is widely acknowledged that intensive livestock farming is under pressure due to several factors. Indeed, it is responsible for about 15% of anthropogenic greenhouse gas emissions (OECD & FAO, 2021) and is associated with the degradation and depletion of land, soil, and water as well as biodiversity loss (Yitbarek, 2019). Not less importantly, intensive livestock farming is deemed to treat farmed animals as units of production rather than sentient beings, entailing practices that include crowded facilities, routine amputations, and brutal slaughter techniques. Besides the animal discomfort, health and quality issues can arise as animals subject to stress and pain are more prone to disease and produce lower quality products (Smith & Lewis, 2019).

At the same time, population growth and rising incomes in developing countries, together with the inability of Western consumers to substantially reduce meat consumption (Tobler, Visschers, & Siegrist, 2012) - despite their nominal willingness to shift towards more sustainable diets (European Commission, 2013) - will inflate the global demand for meat, with expectations suggesting an increase by more than two-thirds by 2050 (FAO, 2018).

Therefore, food systems are called to implement viable actions to meet the increasing demand for protein sources while addressing social and environmental priorities. One of the strategies supported by some actors of the scientific community and policymakers is the promotion of alternative sources of proteins that are obtained from novel sources, including microorganisms (fungi and bacteria), algae and microalgae, and insects (Pojić, Mišan, & Tiwari, 2018) or grown in laboratories. Within such a wider category, an increasing attention are gaining the so-called “meat analogues”, i.e. those alternatives that approximate the sensory characteristics of animal-sourced meats (Lusk, Blaustein-Rejto, Shah, & Tonsor, 2022).

At the moment being, several factors still affect the commercial success of the majority of novel protein sources; technical challenges prevail for some of them (Colgrave et al., 2021), whereas legislative deadlocks are slowing down the market entry of some others.

Nevertheless, several reports predict scenarios where the novel alternative proteins would disrupt the conventional meat industry, unlike the classic vegan and vegetarian meat replacements for which is

expected a growth that will not substantially threaten the existence of intensive livestock farming and the meat industry (e.g. Tubb & Seba, 2021; Gerhardt, 2020).

However, a key issue for the future of all novel proteins is consumers' acceptance (see, among others, Onwezen, Bouwman, Reinders, & Dagevos, 2021; Van Loo, E. J., Caputo, V., & Lusk, 2020).

Therefore, the research question of this paper is about the main drivers and obstacles posed by consumers' perception that foster and hamper the development of those alternative protein sources that fall within the category of "novel foods", i.e. cultivated meat, insect-based food, and novel plant-based products.

Cultivated meat is defined as the meat produced under lab conditions by introducing muscle cells (biopsied from donor bovine animals) to a culture medium, where they proliferate under controlled conditions and develop into muscle fibres (Post, 2012), whereas insect-based food refers to insect species used for human consumption, both whole or as an ingredient in processed food products such as burger patties, pasta, or snacks. The third category under analysis is the novel plant-based food which is made of novel plant-based ingredients, such as heme or seaweed, and includes but is not limited to those alternatives that approximate the sensory characteristics of animal-sourced meats (Lusk, Blaustein-Rejto, Shah, & Tonsor, 2022). The conventional plant-based products, such as soy burgers, are not within the scope of this review, as a category available in the market for many years, therefore lacking the "novelty" feature and, as mentioned above, is not expected to disrupt the current livestock chains.

More specifically, this paper aims at providing a critical assessment of the available literature on consumers' perception concerning cultivated meat, insect-based food, and novel plant-based products with reference to the Italian context.

The reason for investigating Italian consumers' perception towards novel proteins is that meat plays an important role in the Italian traditional cuisine and food culture. Indeed, Italy is where valuable indigenous cattle breeds are reared and well reputed PDO and PGI[1] meat products are produced. As Italian gastronomy impacts gourmets and foodies in Europe and worldwide, the understanding of Italian consumers can play a role to envisage the future of food cultures in other countries, especially where meat plays a crucial role in daily dishes.

Moreover, meat consumption is significant in Italy, making the Italian consumers of meat and meat-based products of interest if novel sources of proteins took hold as substitutes for conventional meat.

[1] PDO (Protected Designation of Origin) and PGI (Protected Geographical Indication) products are the result of the combination of human and environmental factors that are characteristic of a specific territory. The PDO and PGI schemes are defined by the Regulation (EU) 1151/2012.

In 2021, meat consumption in Italy was about 59 kg per person per year[2], comprehensive of fresh and processed meat and meat substitutes, this latter with a negligible 0.1 kg, covering all types of meat-like products that approximate certain aesthetic qualities (primarily texture, flavour, and appearance) or chemical characteristics of specific meat. According to Statista (Fig.1), a slight increase in meat consumption is forecast in the Italian market as the result of two opposite dynamics: on the one hand, an increasing trend in fresh meat and meat substitutes consumption and, on the other hand, a decreasing trend of processed meat consumption over the next few years.

[Figure 1 about here]

These data support the idea that new dietary patterns are taking hold and possibly affecting the Italian consumers' attitudes towards alternative protein sources. Indeed, according to Coop (2021), Italian consumers seem to be more and more sensitive to the negative externalities ascribed to the meat sector and its products for human health, natural resources, and animal welfare. In 2020, more than half of Italian consumers stated to have reduced meat consumption to meet the principles of ethical consumption. In the same year, 8% of Italians declared to be vegan or vegetarian (Eurispes, 2021) and a growing number of consumers labelled themselves as "part-time vegans" (Coop, 2021), a category including consumers who approach the vegan world motivated by health, animal welfare, and environmental principles but are unable to fully join a vegan lifestyle.

Therefore, the emerging consumption trends pose the question about the Italian consumers' acceptance of novel protein sources.

The remainder of the paper is the following: Section 2 describes the aim and how the literature review concerning Italian consumers' perception of three novel protein sources has been performed; Sections 3, 4, and 5 focus on the Italian consumers' perception towards the cultivated meat, insect-based foods, and novel plant-based products, respectively; Section 6 provides an assessment of the state of the art; while Section 7 concludes with some final remarks.

2. Aim and method

In this paper, we aim at providing an assessment of the available literature on consumers' perception towards three novel protein sources, specifically cultivated meat, insect-based foods and novel plant-based products, with reference to the Italian context.

[2] https://www.statista.com/outlook/cmo/food/meat/italy?

93 The research used reference databases (i.e., Google Scholar, Scopus, Science Direct), and included
94 articles from academic journals and papers from conferences over six years (2016-2021). Boolean
95 operators (AND, OR) were used in the research along with the following keywords: insect,
96 entomophagy, plant-based, novel, pulses, algae, seaweeds, alternative protein sources, meat
97 substitutes, meat analogues, synthetic meat, cell-based meat, cultivated meat, clean meat, animal-free
98 meat and slaughter-free meat, chemical meat, artificial meat, and fake meat associated with the words
99 Italian, consumer, Italian market, Italy, perception, willingness, and acceptance.

100 While the literature review specifically focused on studies regarding Italian consumers' acceptance
101 (i.e. 5 for cultivated meat, 16 for insect-based foods and 3 for novel plant-based products Tab. 1),
102 further wider-focus studies were included when the information provided suited the scope of the
103 current review.

104

105 [Table 1 about here]

106

107 **3. Cultivated meat**

108 Cultivated meat[3] represents a scenario of alternative protein sources, although still in its incipient
109 phase. Indeed, cultivated meat is yet to be scaled up at the industrial level, besides being eventually
110 evaluated as a novel food to be allowed into EU markets (Mancini & Antonioli, 2022). Moreover,
111 tasting experiments are not performed within the EU, and consequently, the literature investigating
112 Italian consumers' attitude and perceptions towards this (yet abstract) food is weak.

113 The three available surveys on Italian consumers show quite convergent findings. A generally
114 positive attitude towards cultivated meat was found, ranging from 54 % (Mancini & Antonioli, 2019)
115 up to 78 % of the respondents willing to try cultivated meat (Palmieri & Forleo, 2021). Positive
116 perception is mainly focused on cultivated meat as being able to reduce the negative externalities of
117 intensive livestock farming rather than its intrinsic attributes, i.e. flavour, nutritional and safety
118 characteristics. Such perception is reasonable since no sensory tests have been performed yet to
119 support the intrinsic features of cultivated meat, thus entailing unfamiliar feelings among consumers.
120 Therefore, the main leverages for fostering the acceptance of cultivated meat are rather ethical (i.e.,

[3] Many terms are used for cultivated meat. Some of the most common are: cultured meat, cell-based meat, in vitro meat, clean meat, synthetic meat, artificial meat, animal-free meat, slaughter-free meat, fake meat. They refer to the same product but imply different perceptions of the product (Mancini & Antonioli, 2022).

121 animal welfare, food security, and environmental concerns) centred and sometimes led by curiosity
122 towards an untasted food (Palmieri, Perito, & Lupi, 2020; Piochi, Micheloni, & Torri, 2022).

123 Interestingly, the findings of all surveys show that meat-eaters are potentially interested in cultivated
124 meat more than vegetarians and vegans. This is coherent with several studies according to which
125 people consume meat not because it comes from an animal, but rather despite the fact it comes from
126 an animal (Broad, 2020) and cultivated meat would help to relieve their sense of guilt by providing
127 them with a complement to conventional meat. Quite the opposite, vegetarians and vegans, despite
128 being in favour of any alternative to intensive livestock farming, do not appear willing to taste and
129 consume a product that is anyway derived from an animal source.

130 Both very young (under 25) (Mancini & Antonioli, 2019) and young people (under 30) (Piochi,
131 Micheloni, & Torri, 2022) resulted to be those having the most positive attitude towards cultivated
132 meat. The educational level proved to be significant in one survey only (Mancini & Antonioli, 2019)
133 to the extent that the higher the education degree the more positive attitude towards cultivated meat.
134 The positive perception by youngsters, highly educated respondents, and meat-eaters reflects a
135 willingness to pay a premium price for cultivated meat (Mancini & Antonioli, 2019).

136 Given the unavailability of cultivated meat on EU markets and the foreseen not too short time horizon
137 for its placement on supermarkets' shelves, the available exploratory consumer studies devoted much
138 room to analysing the extent to which information impacts consumers' behaviour.

139 About two-thirds of the Italian consumers declared to have beforehand information on cultivated meat
140 (Mancini & Antonioli, 2019; Piochi, Micheloni, & Torri, 2022), more than what was found in
141 previous studies across Europe, conducted a few years earlier (Verbeke, Sans, & Van Loo, 2015).
142 Consumers awareness has probably been boosted by the increasing attention of the media on the
143 soaring numbers of high-tech start-ups interested in this product that are attracting huge capital,
144 sometimes from world-renowned managers or celebrities of the entertainment industry. According to
145 Mancini & Antonioli (2019), 64% of the participants who were somehow familiar with the topic were
146 willing to try cultivated meat, whereas this percentage plunged to 40% for respondents who had no
147 familiarity with it. These findings are coherent with previous research on the sense of unfamiliarity
148 with novel technologies, such as genetically modified organisms (Frewer et al., 2013) with which
149 cultivated meat is associated (Verbeke et al., 2015), showing that unfamiliarity leads to a lack of trust
150 (Siegrist & Sütterlin, 2017), uncertainty, and concerns over potential adverse long-term
151 consequences.

152 Mancini & Antonioli (2020) also analysed to what extent the provision of positive information affects
153 the perception and acceptance of cultivated meat by measuring the variation in perception and

willingness to try, buy, and pay before and after the provision of positive information related to the product. The results showed that perception is significantly affected when the information concerns safety and nutritional characteristics, whereas the opposite occurs regarding the product flavour. Findings also revealed that, while the willingness to buy increases after providing positive information, the willingness to try does not. Indeed, willingness to try depends upon further stimuli other than information, suggesting a deeper analysis of the food profile, and the values underlying it, of the population of interest. Respondents' perception was less affected by additional information concerning the externalities of cultivated meat, probably because they were aware of such positive effects even before the provision of positive information.

In Piochi, Micheloni, & Torri (2022), the aim of the investigation was the impact of different types of information on consumers' response to cultivated meat. Four information types: human safety (HS); animal welfare (AW); environmental impact (EI); no additional information, were provided to four samples and it was found that additional information on claims related to HS, AW, and EI aspects of cultivated meat had a positive effect on increasing favour for cultivated meat and willingness to substitute conventional meat with cultivated meat. This positive effect of the information in the whole tested population was not specifically linked to any information type (no significant differences were found among the blocks of the information nor across claims) although minor effects were found in some subgroups.

Interestingly, both studies by Mancini & Antonioli (2019) and Piochi, Micheloni, & Torri (2022) found that the provided information impacted females' perception and acceptance more than any other subgroup whereas information was less effective among older respondents, implying that this group prefers to maintain established habits, which can be translated into a cautious attitude towards cultivated meat. Other categories who showed to be less impacted by information were those who do not eat meat, as well as those who do not intend to reduce meat consumption and those who hold a lower educational level (Mancini & Antonioli, 2020). The latter is consistent with previous research reporting that people holding a higher education degree are more likely to engage in analytical thinking (Sinclair, 2014) rather than emotional attitudes, possibly making them more available to new food scenarios than lower educated consumers.

Sometimes contrasting initiatives are suggested to promote cultivated meat; Palmieri & Forleo (2021) recommend marketing strategies supported by highly reputed institutions and targeted to those consumers groups that showed to be most sensitive - young individuals - with the aim of sharing solid scientific evidence about the potential advantages of new food technologies on health, whereas Mancini & Antonioli (2020) believe that too much technical information would be counterproductive

and rather suggest to combine information with an approach based on the "understanding of the food identity profile of the members of the population of interest [...] to tap the psychological variables linked to the system of values that drive food choices" (Faccio & Fovino, 2019, p. 10).

4. Insect-based food

Italy-related studies on consumers' behaviour towards entomophagy flourished in the last years; the strong and rooted Italian food tradition embed certain food neophobia character, attracting the interest of behavioural applied economists, particularly concerning consumers' acceptance of novel foods, such as insect-based ones (Arena et al., 2020; La Barbera, Verneau, Amato, & Grunert, 2018; La Barbera; Lombardi et al., 2019; Shelomi, 2016; Sogari, Menozzi, & Mora, 2017; Verneau et al., 2016, 2020).

The up to now available literature concerning Italian consumers has focused on a few themes, namely, the main barriers to be overcome for reaching a higher acceptance rate towards insect-based foodstuff, consumers' willingness to try and pay for it, as well as the role of information as a driver to increase consumers' acceptance of edible insects.

More than 50% of the respondents express a low-to-negative acceptance of insect foods in Italy (Tuccillo, Marino, & Torri, 2020), with a significant exception of a segment, named 'Rational' consumer group by Verneau et al. (2020), which shows the highest rate of interest and confirms the existence of a niche market of 'early-adopters' (as this group represents 20% of the respondents' panel).

There's a consensus that both appearance and taste are the main barriers to be overcome, with gender and education playing a significant role (Arena et al., 2020; Cicatiello, De Rosa, & Lacetera, 2016; Palmieri, Perito, Macrì, & Lupi 2019; Tuccillo, Marino, & Torri, 2020) to the extent that males, as well as higher-educated people, show a higher willingness to eat insects. Highly educated people may embed a stronger environmental awareness, explaining their more positive attitude towards insect-based food (Cicatiello, De Rosa, & Lacetera, 2016). Moreover, the current literature is unanimous in finding the more negative attitude of female consumers towards insects, even though little has been said about the motive for such difference. Cicatiello, De Rosa, & Lacetera (2016) argue that, given the yet central role of women in housework activities in Italy (as in further Mediterranean countries), the introduction of insects within the daily diet may be perceived as a household management issue. Insect foods simply do not adhere to the image of Western consumers' food, and this probably represents the most significant barrier to the successful introduction of insect foods into Italian

consumers' routine: a strong cultural and psychological prejudice (Tan, Verbaan, & Stieger, 2017), as Western areas are not experienced nor familiar with insects as food, so that social norms regarding entomophagy often relates with uncleanliness and health risks (Hartmann, Shi, Giusto, & Siegrist, 2015; Hartmann & Siegrist, 2017; Jensen & Lieberoth, 2019).

Neophobia is very often mentioned when consumers' acceptance of edible insects is considered. Indeed, almost all works blame neophobia as the main enabler for negative sentiments towards insect-based foods, although Iannuzzi, Sisto, & Nigro (2019) conclude that neophobia itself should not apply to insect foods as it entirely depends on the nature of the novel food and not on its 'novelty'. That is to say, there is an anchored behaviour that prevents some consumers to be willing to eat insect foods, hence cultural references are pivotal.

Research investigating the impact of information on consumers' acceptance of insect-based foods shows controversial findings, mainly dependent upon the type of information provided. Conti et al. (2018) find that providing information about the nutritional value of eating insect foods – especially on essential amino acids daily requirements – does not entail any significant increase in participants' willingness to accept them, in line with several studies (Hartmann, Shi, Giusto, & Siegrist, 2015; Verbeke, 2015; Iannuzzi, Sisto, & Nigro, 2019); on the contrary, information about the future challenge of food security that worldwide food systems will have to face seems to play a significant role in shaping insect foods acceptance into the Italian society, as also asserted by Cicatiello, De Rosa, Franco, & Lacetera (2016). According to Iannuzzi, Sisto, & Nigro (2019) and Menozzi et al. (2017), the health and environmental benefits of insect foods seem successful elements on which leveraging interventions (e.g. advertising campaigns from agri-food companies). According to Lombardi et al. (2019), when not provided with any piece of information, consumers equally-to-slightly-negative price insect foods; while, when information on the benefits of insects is given, WTP increases for all insect-based products and the disgust sensation weakens (Mancini et al., 2019). The idea that peers' recommendations together with familiarity with the food item increase the willingness to consume insect foods is cemented by the study of Sidali, Pizzo, Garrido-Pérez, & Schamel (2019), where is highlighted that introducing cultural contextual information about insects is pivotal for preventing the false assumptions on this novel food. Indeed, both either personal or close network past experiences with insect foods represent pieces of information (positively) shaping consumers' attitudes (Conti et al. 2018; Menozzi et al., 2017; Roma, Ottomano Palmisano, & De Boni 2020). Nevertheless, Arena et al. (2020) find no significant effect of information on consumers' perception of insect food, as no statistically significant difference arose between the 'informed' and 'non-informed' groups. This hints at the fact that consumers' prejudices endure even when positive information is provided (Conti, Costa, Balzaretti, Russo, & Tedesco, 2018).

The little attention paid to the cuisine-related aspects has likely played a major role in the persistence of negative prejudices (Deroy, Reade, & Spence, 2015; Shelomi, 2016; Vecchione et al., 2012). Therefore, a path that seems to be crucial for a more targeted behavioural control, is the development of insect foods by mimicking those food products already rooted in Western diets, like chocolate cookies or pizza (Arena et al., 2020; Cicatiello, Vitali, & Lacetera, 2020; Iannuzzi, Sisto, & Nigro, 2019; Roma, Ottomano Palmisano, & De Boni, 2020; Sogari, Menozzi, & Mora, 2017). As insect foods do not adhere to the image of Western consumers' food, processing them beyond recognition may represent an (initial) step towards their acceptance and routinely consumption. Lombardi et al. (2019) found that staple (and savoury) foods, like pasta (with insects as ingredients), are deemed more palatable than sweet foodstuffs such as chocolate bars or cookies: insects are seen as substitutes for protein hence sweet preparations are less suitable to Italian consumers, as found by more general studies (Shelomi, 2015; Tan et al., 2015). In line with their conclusions, Conti et al. (2018) find that insect (salty) snacks are higher appreciated. The way the insect food is prepared and presented undoubtedly entails a significant impact on the willingness to consume such foods: the lesser the insect is visible, the higher the probability for the consumer to eat the insect-based product, as this is valid also for other Western countries (de-Magistris, Pascucci & Mitsopoulos, 2015; Schösler, Boer de, & Boersema, 2012).

There's an important limitation in almost all studies cited above that referred to young and well-educated consumers, as the majority of studies took place within Italian Universities or relied on academic networks. This, on the one hand, may find a justification as young and well-educated consumers will be those potentially consuming insect foods as part of their diet in the next future (Sogari, Menozzi, & Mora, 2017, 2019), proving to represent the most interesting niche market for (insect) agri-food companies (Cicatiello et al., 2020; Gmuer, Nuessli Guth, Hartmann, & Siegrist, 2016; Iannuzzi et al., 2019; Roma Ottomano Palmisano & De Boni, 2020; Schouteten et al., 2016; Verneau et al., 2020) but, on the other hand, such limitation calls for more research efforts towards different segments within the young-adults bandwidth and testing other types of insect-food products.

As a main result, this review suggests that insects may be first introduced as ingredients, coherently with what was reported by several Western-related works (Caparros Megido et al., 2016; Cunha, Cabral, Moura, & de Almeida, 2018; Gmuer, Nuessli Guth, Hartmann, & Siegrist, 2016; Iannuzzi, Sisto, & Nigro, 2019; Roma, Ottomano Palmisano & De Boni, 2020; Tan, Fischer, van Trijp, & Stieger, 2016). This entails that further technological improvements seem to be needed for a smoother acceptance of insect foods and to promote their introduction into regular diets (Tan, Verbaan, & Stieger, 2017). Therefore, such a transitional phase could represent the best-suited marketing strategy

to introduce insects into Western diets before a wider diffusion (La Barbera, F., Verneau, F., Amato, M., & Grunert, K.; Caparros Megido et al., 2016; Iannuzzi, Sisto, & Nigro, 2019; Mancini et al., 2019).

5. Novel plant-based products

For a long time, soybean has been the most popular ingredient in plant-based meat, although companies recently started introducing other sources. Eventually, these ingredients have become prominent due to advances in technology enabling superior functionality, including more meat-like flavour profiles, textures, and appearances (Lusk, Blaustein-Rejto, Shah, & Tonsor, 2022).

To the best of our knowledge, two papers only (Palmieri & Forleo, 2020, 2021), that report the findings of the same survey, analysed consumers' perception of novel plant-based sources of proteins, namely seaweeds, in the Italian context at the time of this writing. A third paper focussed on consumers' perception of the construction of a microalgae production plant rather than the product microalgae itself. However, some evidence can be drawn. The theme around which Palmieri and Forleo (2020, 2021) focussed their survey was the overall acceptance, more specifically the familiarity with seaweeds, and the willingness to try them. As a result, 75% of the sample composed of 257 Italian consumers had heard about edible seaweed whereas the percentage of those who had eaten them was not very high (57%) compared with other studies such as Birch, Skallerud, & Paul (2019), which reported a past consumption of 75% for their sample of Australian consumers. Nevertheless, 77% of the sample of Italian interviewers were willing to eat seaweed, coherently to the available literature (Al-Thawadi, 2018; Bührlen, Canavari, & Breitschopf, 2005).

The socio-demographic predictors of acceptance, the most common objections and perceived benefits, as well as the role of information in consumers' perception, are the main issues of the third research (Lafarga et al., 2021) that investigated the attitude of citizens in Almeria (Spain) and Livorno (Italy) towards the construction of a microalgae production plant and bio-refinery. One main result is the weaker consciousness of Italian consumers compared to Spanish respondents about microalgae, provided that approximately 60–70% of the Italian respondents neither agreed nor disagreed with the production of microalgae, independently o the location of the facility. What the two cities' samples resulted to have in common is the socio-demographic response to the extent that the share of respondents over 49 years old agreeing with the construction of both microalgae's production plant and bio-refinery was higher than the sample average in both cities, and the higher the educational attainment, the higher the acceptance rate of respondents.

Safety, health, and the economy (i.e., the opportunity for new jobs) are the main reasons for agreeing with this type of production in the Italian sample, consistently with the motivations mentioned by Spanish citizens in a survey that took place in 2020 (Lafarga et al., 2021). Not surprisingly and coherently with other studies about consumers' perception of cultivated meat and insect-based food (e.g. Mancini & Antonioli, 2020; Conti et al., 2018), information provision positively impacts the consumers' acceptance levels. Indeed, increasing knowledge about microalgae and microalgae-derived products led to a shift from undecided respondents to positive answers. Results suggest that increasing consumer knowledge about the environmental and health benefits of microalgae could lead to a higher interest in the topic and acceptance of microalgae-based processes and products. The findings also suggest that information can be used to address consumers' worries, in particular risk perception which is the key factor influencing consumer interest in production technologies, coherently with previous research (Cardello, Schutz, & Lesher, 2007).

Although the very limited numbers of studies, the available literature agrees in providing two main recommendations for increasing seaweeds acceptance and consumption; the first one consists of the promotion of institutional and commercial campaigns to raise awareness about the health characteristics and the large variety of sensory qualities (such as flavour, texture, and colour) of seaweeds; and, the second one focuses on getting the consumers acquainted with these products through seaweeds tasting, especially combined with familiar products such as seaweed-based snacks (Chapman, Stévant, & Larssen, 2015). For instance, the Italian guidelines for healthy eating, recommending the consumption of seaweeds as a source of iodine and Vitamin B12, are mentioned as an excellent tool to increase awareness (Palmieri & Forleo, 2021). It is reasonable to envisage that more familiarity will gradually turn the consumer into a diet that includes an increasing share of this product category.

6. Discussion

6.1 Cross-sectional reading of the literature review

The literature review conducted on consumers' perception towards novel protein sources in the Italian context reveals a common line of investigation to the extent that the surveys mainly analyse the barriers and the role of information as a driver for their acceptance.

According to the findings, the same profile of consumer is likely to be favourable to both cultivated meat and insect-based food, i.e. a young and highly educated consumer, with some gender differences. Indeed, males result more positive than females, this latter becoming favourable once

informed about the positive externalities of cultivated meat and insect-based food on the environment and food security.

What is very different in consumers' perceptions towards the two novel products is the distrust origin: technological for cultured meat, as this being perceived as a food disconnected from the natural production processes, whereas a culture-related opposition prevails for insects, that are out of the collective food imagination of Western consumers. The third category – novel plant-based food – seems to be less problematic, as it does not present the technological and cultural barriers of the other two novel protein sources.

Information results to be the best strategy to increase Italian consumer acceptance of all novel protein alternatives. Indeed, this is true for cultivated meat, especially at this stage when the consumer is not able to test the product yet and verify the contents of the information, and for insects and plant-based food as well. However, the latter categories benefit from two conditions precluded to cultivated meat. Firstly, insect foods and plant-based products are going to be or are already available for tasting, thus making their promotion easier to succeed; secondly, they can be easily used as ingredients for the production of familiar and attempting foods.

The main outputs of the literature review are shown in Tab. 2.

[Table 2 about here]

As a matter of fact, the three alternative protein sources take along specific challenges as they differ in technological innovation, face different degrees of institutional barriers and have different impacts on the environment (Mancini & Antonioli, 2022).

Indeed, cultivated meat requires a higher degree of technological change compared to plant-based products or edible insects (Tomiyama et al., 2020) and scientists are still working to definitively overcome some major technical barriers such as an animal-free medium to meet the animal rights activists' expectations or the production of structured meat cuts, at least for beef production (Allan, De Bank, & Ellis, 2019). These challenges have led to the assertion that "in vitro meat is still in its infancy" (Chriki & Hocquette, 2020; p.7). What's promising for the future of cultivated meat is that such highly technological foods may have an advantage in that they can catch the investments of innovative companies willing to support technological breakthroughs, which does not seem to be true for other alternative protein solutions as they lack the involvement of powerful corporates (van der Weele et al., 2019).

The regulatory frameworks differ as well; plant-based protein sources fall under to a large extent established legislation, whereas insects are gradually gaining EU legal authorizations on diverse insect-based products[4]; differently from cultivated meat whose legal reference framework seems to be still very far from a setting in the EU (Seehafer & Bartels, 2019).

Lastly, the environmental impact differs among alternative protein categories. Although the early studies quantified drastic reductions in energy consumption, land and water usage, and energy consumption for cultivated meat compared to conventional livestock farming (Tuomisto & Teixeira De Mattos, 2011), it has been more recently acknowledged that the environmental assessment of its production needs more data, particularly related to inputs and the industrial-scale production (e.g. Mattick, Landis & Allenby, 2015). Conversely, it is well established that insects require no land, little food and water for their growth, and have a rapid growth rate (Premalatha, Abbasi, Abbasi & Abbasi, 2011), whereas plant-based foods tend to be less resource-intensive and environmentally destructive, especially due to lower levels of greenhouse gas emissions compared to raising animals for human consumption (Lynch, Johnston & Wharton, 2018) to different extents depending on the specificity of the production process.

6.2 Future consumption scenarios

Despite a very uncertain future for some of these alternative protein sources, the report of Tubb and Seba (2021) depicts two technological innovations - precision fermentation (i.e., the combination of precision biology with the process of fermentation) and cell-based meat as being able to reduce the cost of modern foods by up to 80% compared to the products they would replace. A second report by Gerhardt et al. (2020) predicts a scenario in which cultivated meat represents 35% of the global meat market in 2040, with the remaining shares divided between conventional (40%) and novel vegan meat replacements (25%). Unlike classic vegan replacements (e.g., tofu, seitan, mushrooms, or jackfruit), novel vegan meat replacements would benefit from sensory profiles much closer to conventional meat due to the use of haemoglobin and binders extracted via fermentation from plants. Whereas classic vegan replacements are estimated unlikely to grow beyond the current trend, the report forecasts the disruption of the conventional meat industry due to the inexorable technological progress of start-ups working on cultivated meat and novel vegan meat replacements, supported by large corporations funding. The report closes up by stating that cultivated meat will eventually prevail over the novel

[4] On 10 February 2022, the Commission has authorised the placing on the market of a third insect, *Acheta domesticus* (house cricket).

vegan meat replacements in the long run, whereas the latter is depicted as a transitional product category that will bridge the consumers to the new food model based on cell-based meat.

Interestingly, consumer resistance to modern food disruption is not considered a major barrier as "resistance is never as deep-rooted or intransigent as we may think" (Tubb and Seba, 2021, p. 35). This still has to be proved in the Italian market, in particular concerning those alternative protein sources that have not been tasted by consumers yet, in particular cultivated meat and, to a large extent, insects as well. As mentioned, cultivated meat acceptance finds the main obstacles in food and food technology neophobia (Palmieri, Perito, & Lupi, 2020; Piochi, Micheloni, & Torri, 2022) and expectations of taste (Mancini & Antonioli, 2019) whereas entomophagy is mainly rejected based on the disgust factor (Sogari, Menozzi, & Mora, 2017; Tuccillo, Marino, & Torri, 2020) and the fear of health risk (Moruzzo, Mancini, Boncinelli, & Riccioli, 2021). Moreover, these two novel foods are entering the market at a very crucial moment. COVID pandemic and the recent start of the military conflict in Ukraine represent societal events that seem to beat a negative influence on the acceptance rate of technological and novelty factors in food production; indeed, Italian consumers tend to increasingly associate positive perceptions with local, traditional and natural (low-processed) foods (Coop, 2021).

The acceptance of plant-based foods seems to be less challenging, both for their availability – at least, for some of them - on supermarkets' shelves, thus making these products more familiar to consumers, and because they are not perceived as intensively technological processed foods. Therefore, their acceptance could be quite easily increased by reducing the health risk perception through information (Lafarga et al., 2021).

6.3 Communication and promotion strategies

It is likely that environmental sustainability will be one of the main leverages for the promotion of alternative protein sources in the Italian market, but it is the authors' suggestion not to underestimate that the concept of sustainability in Italian consumers' eyes greatly differs and encompasses several values. For 33% of Italians, a food product is sustainable when organic, environmentally friendly produced and does not use additives or antibiotics. A similar percentage associates sustainability with products made from eco-friendly materials and packaging. For 25 % of Italian consumers, sustainability has to do with a controlled supply chain, local or domestic production while for 9% a food product is sustainable when fair remuneration to workers and respect for their rights is granted (Coop, 2021). Therefore, despite an increasing interest in sustainable food products, the concept of

sustainability is subject to a wide range of interpretations that has to be taken into account in the definition of marketing strategies for alternative protein sources.

What seems to be underestimated in the up-to-now available literature concerning Italian consumers' perception is the role that intermediate institutions may play, in particular producers' associations and other agents of the conventional meat supply chain. At the time being, despite some concerns expressed towards all types of alternative protein sources, the spotlight is very much on cultivated meat. In this regard, Italian producers' associations have addressed major concerns about the future of national livestock farming. With a production value of almost 10 billion euros, the Italian meat sector accounts for about one-fifth of the value of national agricultural production; in some areas, it can even exceed 30% of the value of agricultural production. Livestock farming also activates both up and downstream agents along the supply chain, such as the feed industry, with a total turnover of over 7.5 billion euros (Assalzoo, 2020), besides the production of PDO and PGI meat products (Mancini, 2012) which account for 1.9 billion euros, rising to 5 billion euros on the final consumer market (Ismea - Qualivita, 2021).

Producers' associations also claim the remarkable role of animal husbandry in the production of biogas, electricity and hydrogen, and more generally as a main element for the circular economy. Furthermore, the by-products of livestock as manure, are a source of nitrogen, besides other essential organic minerals especially used in organic farming as soil conditioners to improve soil fertility. In such a framework, some producers' associations have taken action in consumer communication. Coldiretti, the largest Italian producer association accounting for 1.5 million members, recently issued a nine minutes video entitled "Frankenstein meat, the future to fear"[5] in which the association explains its reasons for claiming the potential benefits advocated by cultivated meat supporters false and misleading. It is interesting to briefly analyse the narrative and the wording chosen for the video campaign. The video starts by providing a very technical description of the process using scientific terms[6]. Cultivated meat is then blamed for lack of natural origin, likely to be more environmental impacting than conventional meat farming and potentially dangerous for human health because of the residues of organic and chemical molecules in the water. Much room is also devoted to the explanation of how foetal serum is provided, being extracted by pregnant cows, and the impact that foetal serum procurement will have on livestock farming that will turn to become a foetal provider. Cultivated meat is finally presented as a business that will benefit large corporations, thus contributing to the marginalisation of farmers and the local systems of production.

[5] https://www.youtube.com/watch?v=n8RlOGNQ3_k

[6] As previously mentioned, technical descriptions of novel foods are likely to produce negative reactions by raising a sense of unfamiliarity and discomfort. See also Bryant & Dillard (2019).

This resembles an example of how a sectorial association is attempting to preserve the traditional meat sector by raising societal aversion, disseminating incomplete information and inflating alarmism on scientific issues that have not been cleared yet by any robust scientific result.

It is hardly predictable whether such communication will impact consumer behaviour in particular those segments who seem to be the potential consumers of cultivated meat: young and highly educated people who tend to prefer sources of information alternative to institutional bodies. However, it is likely that some stakeholders' lobbying activities will be able to slow down a legislation framework favourable to meat analogues and rather support regulations that act as entry barriers for companies, thus hindering their drive for innovation (Lähteenmäki -Uutela, Rahikainen, Lonkila, & Yang, 2021).

However, what's up most evident in Italy at the moment is the chaotic flow of information provided by media that misleads consumers. Cell-based meat is often described as an artificial product made in laboratories from scratch, whose animal cell origin is neglected; moreover, different types of meat analogues are named under the same term. Newspapers, magazines, television, and social media label both cultivated meat and plant-based meat as "synthetic meat". Because of the bivalent use of this term, many consumers believe that cell-based meat is available on the market, raising misunderstandings that will ultimately damage consumers and potential developments for such novel foods production. To this extent, producers' associations' intervention is understandable, particularly their call for a clear legislative framework on the naming/labelling of alternative (hence not even similar because of a very different nature) products - which is not the case, so far, neither at EU nor at the national level[7].

7. Final remarks

Whereas some authors argue that alternative protein products compete against each other (Sexton, Garnett, & Lorimer, 2019), the authors' opinion is they are likely to have different roles depending on their different strengths and weaknesses. Novel plant-based food and edible insects represent a valuable alternative protein source from the nutritional perspective. Moreover, plant-based food can

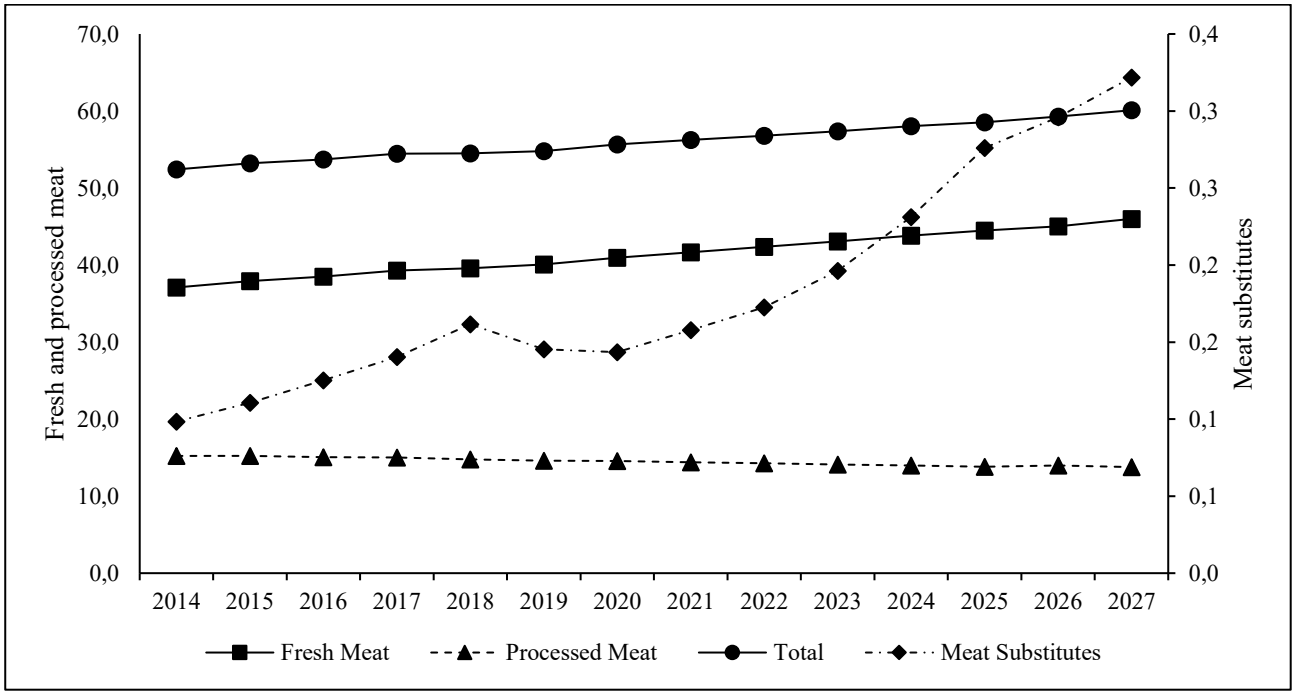
[7] In the case of milk alternative products, the words milk, cheese, cream, and others, were prohibited for products not derived from mammary secretions - see the European Court of Justice case of 2017 'TofuTown' decision that denied the use of dairy names even when they are sided by clarifying designators such as 'vegan' or 'plant-based' (Carreño & Dolle, 2018). Differently, although specific names for beef, pig meat, and chicken are protected, the names referring to shapes and composition of meat products (steaks, sausages, and burgers) are not (Lähteenmäki -Uutela, Rahikainen, Lonkila, & Yang, 2021). An additional confusing factor resides in the differences between EU countries' legislations. An example is provided by the French food labelling law in force since the beginning of 2021 that prevents plant-based products from using names related to the shapes and composition of meat products.

503 be made available to a wide range of consumers, embracing vegetarians and vegans as well. However,
504 palatability, appearance, flavour, and texture still represent critical weaknesses that need to be
505 overcome. On the opposite, cultivated meat is an animal's muscle-based product representing the
506 only meat alternative comparable to traditional meat. This feature makes it unsuitable or undesirable
507 for some segments of consumers but appealing to some others, specifically meat consumers who are
508 not willing to reduce or drop out of meat consumption, but are keen to reduce their environmental
509 impact. However, major barriers, mainly related to the scaling-up of production and the consumer
510 market price, still have to be overcome. It is currently very hard to predict the market share that these
511 alternative protein sources will be able to gain in the Italian market but it seems reasonable to envisage
512 a complementary, if not even partially supplementary, relationship with traditional meat.

513 Many factors play a role in alternative protein source diffusion, including technological progress,
514 price, industry communication, and, last but not least, institutional support. Indeed, the latter may
515 resemble the turning point for avoiding harsh confrontations between the traditional meat sector and
516 societal urgencies. Agri-food policies may need to seriously consider the effects of alternatives on
517 the conventional side of the production process, offering economic and financial solutions to either
518 support and smooth the transition from conventional to alternative, or provide aides or solutions to
519 avoiding a massive exit from the sector and its welfare-related consequences (Mancini & Antonioli,
520 2022). On the consumption side, the choices of today's very young consumers, supported by their
521 ethical principles, will contribute to deciding the future of the market for these products.

522
523

Fig.1. Meat and meat substitutes consumption per capita (kg), Italy (2014-2027)



Source: authors' elaboration on Statista https://www.statista.com/outlook/cmo/food/meat/italy

Authors	Publication year	Title	Journal
Cultivated meat			
Piochi et al.	2022	Effect of informative claims on the attitude of Italian consumers towards cultured meat and relationship among variables used in an explicit approach	Food Research International
Mancini, Antonioli	2020	The role of information on consumer acceptance of Novel Food: The cultured meat	BioLaw Journal
Mancini, Antonioli	2020	To What Extent Are Consumers' Perception and Acceptance of Alternative Meat Production Systems Affected by Information? The Case of Cultured Meat	Animals
Palmieri et al.	2020	Consumer acceptance of cultured meat: some hints from Italy	British Food Journal
Mancini, Antonioli	2018	'Exploring consumers' attitude towards cultured meat in Italy	Meat Science
Novel plant-based products			
Lafarga et al.	2021	'Consumer Attitudes towards Microalgae Production and Microalgae-Based Agricultural Products: The Cases of Almería (Spain) and Livorno (Italy	ChemEngineering
Palmieri, Forleo	2021	An Explorative Study of Key Factors Driving Italian Consumers' Willingness to Eat Edible Seaweed	Journal of International Food & Agribusiness Marketing
Palmieri, Forleo	2020	The potential of edible seaweed within the western diet. A segmentation of Italian consumers'	International Journal of Gastronomy and Food Science
Insect-based food			
Arena et al.	2020	Exploring consumer's propensity to consume insect-based foods. Empirical evidence from a study in Southern Italy	Applied System Innovation
Cicatiello et al.	2020	How does it taste? Appreciation of insect-based snacks and its determinants	International Journal of Gastronomy and Food Science
Roma et al.	2020	Insects as novel food: A consumer attitude analysis through the dominance-based rough set approach	Foods
Tuccillo et al	2020	Italian consumers' attitudes towards entomophagy: Influence of human factors and properties of insects and insect-based food	Food Research International
Iannuzzi et al.	2019	The willingness to consume insect-based food: An empirical research on italian consumers	Agricultural Economics
Lombardi et al.	2019	Willingness to pay for insect-based food: The role of information and carrier	Food Quality and Preference

Mancini et al.	2019	Factors predicting the intention of eating an insect-based product	Foods
Palmieri et al.	2019	Exploring consumers' willingness to eat insects in Italy	British Food Journal
Sidali et al.	2019	Between food delicacies and food taboos: A structural equation model to assess Western students' acceptance of Amazonian insect food	Food Research International
Sogari et al.	2019	The food neophobia scale and young adults' intention to eat insect products	International Journal of Consumer Studies
Conti et al.	2018	Survey on food preferences of university students: from tradition to new food customs?	Agriculture
Sogari et al.	2018	Sensory-liking expectations and perceptions of processed and unprocessed insect products	International Journal on Food System Dynamics
Menozzi et al.	2017	Eating novel foods: An application of the Theory of Planned Behaviour to predict the consumption of an insect-based product	Food Quality and Preference
Sogari et al.	2017	Exploring young foodies′ knowledge and attitude regarding entomophagy: A qualitative study in Italy	International Journal of Gastronomy and Food Science
Cicatiello et al.	2016	Consumer approach to insects as food: barriers and potential for consumption in Italy	British Food Journal
Verneau et al.	2016	The effect of communication and implicit associations on consuming insects: An experiment in Denmark and Italy	Appetite

Source: authors' elaboration.

Table 1. List of references per category of alternative protein foods.

	Drivers for consumption	Barriers to consumption	WTT*	WTB**/ WTP***	Profile of potential consumer	Recommendations
Cultivated meat	• Ethical centred externalities (Mancini & Antonioli, 2019) and curiosity (Palmieri et al., 2020; Piochi et al., 2022). • Information on safety and nutritional characteristics (information overcomes rejection in particular when addressed to females). • Familiarity with the topic (Mancini & Antonioli, 2019).	• Unfamiliarity (Mancini & Antonioli, 2019; Palmieri et al., 2020; Piochi et al., 2022).	• 78 % of the respondents (Palmieri & Forleo, 2021). • 64% of those familiar with the topic; 40% of respondents who had no beforehand information (Mancini & Antonioli, 2019). • Additional information does not increase WTT (Mancini & Antonioli, 2019).	• WTB increases after positive information (Mancini & Antonioli, 2019). • Youngsters, highly educated respondents, and meat-eaters are more willing to pay a premium (Mancini & Antonioli, 2019).	• Meat eaters (Mancini & Antonioli, 2019; Palmieri et al., 2020; Piochi et al., 2022). • Very young (<25) (Mancini & Antonioli, 2019) and young people (<30) (Piochi et al., 2022). • Highly educated consumers (Mancini & Antonioli, 2019).	• Scientific communication on health advantages to young individuals (Palmieri & Forleo, 2021). • Combining information with an approach based on the understanding of the food identity profile of the population of interest (Mancini & Antonioli, 2020).
Insect-based food	• Information on environmental and health related externalities (Cicatiello et al., 2016; Menozzi et al., 2017; Sisto & Nigro, 2019; Sidali et al. 2019). • Either personal or close network past experiences with insect foods (Menozzi et al., 2017; Conti et al. 2018; Roma et al., 2020).	• Appearance and taste (Cicatiello et al., 2016; Palmieri et al., 2019; Arena et al., 2020; Tuccillo et al., 2020). • Cultural rejection (Iannuzzi et al., 2019)	• Low WTT due to cultural prejudice (Iannuzzi et al., 2019). • Familiarity increases WTT (Sidali et al., 2019).	• After information, WTP increases and the disgust sensation weakens (Mancini et al., 2019).	• Highly educated and male consumers (Cicatiello et al., 2016).	• Development of insect-based foods by mimicking familiar food products (de-Magistris et al., 2015; Sogari et al., 2017; Iannuzzi et al., 2019; Lombardi et al., 2019; Arena et al., 2020; Roma et al., 2020; Cicatiello et al., 2020).
Plant-based food	• Safety, health and positive economic impacts are the main reasons for consumers' acceptance of seaweed plants (Lafarga et al., 2021). • Environmental and health related info (Lafarga et al,, 2021)		• 77% of the sample (Palmieri & Forleo 2020; 2021).		• The higher the educational attainment of respondents, the higher the acceptance of construction of seaweed plant (Lafarga et al., 2021). • Over 49 years old respondents agree on seaweed plant construction above the sample average (Lafarga et al., 2021)	• Promotion through campaigns about the health characteristics and sensory qualities and getting the consumers acquainted through seaweeds tasting, combined with familiar products (Palmieri & Forleo, 2020; 2021).

534 *Willingness to try (WTT)**willingness to buy (WTB) ***willingness to pay (WTP)
535 Source: authors' elaboration.
536 **Table 2.** Main finings of literature review on consumers' acceptance of cultivated meat, insect-based and plant-based food within the Italian context

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