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Consumer Valuation for Low-Carbon Emission Butter

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The environmental impact of food production, and the healthiness of food products are among the most relevant trends that affect consumer food choices (Grunert, 2013). In this context, the latest data from the Food and Agriculture Organization (FAO) indicates that aggregate agriculture-related activities, including agriculture-related land use along the supply chain, contribute approximately to 19.8% of the global anthropogenic greenhouse gas (GHG) emissions (FAOSTAT, 2020). Specifically, livestock farming accounts for 15% of the global GHG emissions (Tseten et al., 2022). In the European countries, the largest livestock GHG emissions derives from the dairy sector, involving the enteric fermentation from ruminants. Accordingly, the ruminant livestock production system generates approximately 44% of CH_4 emissions which is a main component of the GHG (Shields & Orme-Evans, 2015) resulting in negative effects on the environment. Furthermore, inappropriate consumption of saturated fat in animal-based food products (e.g. dairy products) may associate with negative human health effects, such as the increased risk of cardiovascular diseases, and other physiological disorders (Hooper et al., 2020).

Among others, a solution to reduce the environmental impact of the current livestock system, and the saturated fat content of the derived dairy products is to modify the conventional livestock production system by adopting novel, but easily adopted feeding strategies for cows (Toprak, 2015). Hristov et al. (2013) summarized the enteric CH_4 mitigation practices in terms of feed supplements in cows' diet. A possibility, is that by adding additives derived from plants (i.e. plant oil, oil seeds, etc.) into the feed of cows could significantly reduce the non-CO_2 GHG emissions. For example, it was estimated that between 14% to 17% reduction in GHG emissions from cows could be obtained by adding lipid supplements into the cows' diet. For instance, by adding rapeseed oil (*Brassica napus*) into cows' diet can have a great potential to decrease the proportion of saturated fatty acids on the derived dairy products, and substantially reduce ruminal CH_4, and hydrogen emission (Halmemies-Beauchet-Filleau, 2019).

Since the adoption of new feeding practices could be expensive and challenging for dairy producers, research should be conducted to investigate consumer acceptance for dairy products derived from cows fed with a diet containing rapeseed oil. To the best of authors' knowledge, there is no previous study that have investigated consumer acceptance for dairy products derived from cows fed with a diet containing rapeseed oil.

To fill this void, using a hypothetical choice experiment (CE), we investigated Finnish consumers' preferences and willingness to pay (WTP) for a new type of butter, which was derived from milk produced from cows fed with a diet enriched with rapeseed oil. Moreover, we investigated the effect of consumer characteristics (i.e. socio-demographics, habits, and attitudes) on their WTP for the new type of butter, and the existence of different consumer segments.

We used a questionnaire including a CE, and several questions related to consumer characteristics (i.e. habits, attitudes, and socio-demographics). The CE was composed by a series of choice tasks, where participants were presented with different hypothetical purchase situations (i.e. choice tasks) consisting of three products options, such as two butter product options, and one opt-out option. The products were created based on four attributes levels: "type of feed" (regular feed or rapeseed feed), "saturated fat content" (reduced saturated fat or regular saturated fat), "Carbon Trust label" (no label or with Carbon Trust label), and "price" (€2.95/500g; €3.95/500g; €4.95/500g; €5.95/500g). Using the software Ngene, the selected attributes and their levels were used to generate an orthogonal fractional factorial design that resulted in the creation of 24 choice sets, which were then divided into two blocks of 12 choice tasks each to prevent respondents' fatigue. The survey was conducted online involving 320 participants in Finland using Qualtrics LLC (Provo, US). Participants were recruited based on their age, gender, and income according to national statistics. Only participants older than 18 years old, who were responsible for at least half of household grocery purchase, and ever bought

butter in the last three months were involved in this study. Data were analysed using the Discrete Choice models (DCMs), including the Mixed Logit, and Latent Class logit models by using the STATA 16.1 software.

Several interesting results were found. First, on average consumers prefer low price butter derived from milk produced by cows fed with regular feed that carries the 'Carbon Trust' label and it is labelled with the claim 'Reduced saturated fat'. Second, we found that consumers who prefer butter derived from milk produced by cows fed with a diet containing rapeseed oil tend to prefer more butter labelled with the claim "Reduced saturated fat", and branded with the "Carbon Trust label". Third, we found that younger, and more educated consumers tend to prefer more butter derived from milk produced by cows fed with a diet containing rapeseed oil. Fourth, we identified four different consumer segments. Specifically, the larger segment of consumers (32%) was willing to pay a premium price for butter derived from milk produced by cows fed with a diet containing rapeseed oil, labelled with the claim "Reduced saturated fat", and branded with the Carbon Trust label ("Healthier & Environmentalist"). Butter purchases for consumers in groups 2 "Price sensitive" (28%), and 3 "Neutral" (22%) were driven by low price. Lastly, "Traditionalist" consumers (18%) were strongly willing to pay a higher price for butter derived from milk produced by cows fed with regular feed.

This study provided a first attempt to investigate consumer preferences for dairy products produced using milk originated by cows fed with oilseed supplements. These findings provide useful insights into the psychology of consumers' acceptance and attitudes for low-carbon emission and low-saturated butter, which can be used in communicating the nature of the new feeding strategy to the public. Finally, the results have important implications for future labelling policies as well for product development, and marketing strategies of dairy producers.

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