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Animal welfare has priority: Swiss consumers' preferences for animal welfare, greenhouse gas reductions and other sustainability improvements in dairy products

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ABSTRACT

Animal welfare is at the forefront of the debate on sustainable food systems. However, animal welfare improvements often imply higher costs for producers. We explored whether Swiss consumers are willing to contribute monetarily to such improvements through an increase in prices of butter or milk. Based on a discrete choice experiment with 986 Swiss consumers, we investigated preferences for two animal welfare improvements in the dairy industry – loose housing and farm killing – as well as for organic production, origin of product, and greenhouse gas (GHG) reductions. Furthermore, we investigated how consumers perceive a potential conflict between GHG reductions and animal welfare concerns. Half of our sample faced increases in milk prices; the other half faced increases in butter prices. Findings indicate that animal welfare is of higher importance to consumers when compared to the other attributes under analysis. Consumers oppose GHG reductions associated with deteriorations in animal welfare and are willing to pay for improvements in housing conditions and a less stressful killing of the animals. Improvements in animal welfare could be crucial for dairy industry actors and provide strong arguments in communicating benefits of dairy products to consumers.

1. Introduction

The debate on sustainable food systems emphasizes reducing animal-sourced foods for environmental and health benefits (e.g., Godfray et al., 2018; Fesenfeld et al., 2023; Springmann et al., 2018; Willett et al., 2019). Dairy products could play a role in future food systems prioritizing circularity principles – e.g., by utilizing food industry co-products, food waste, and grassland resources for feeding livestock (van Selm et al., 2022). Due to the high conversion losses associated with feeding concentrates to human-consumed livestock, with a higher efficiency of ruminants harnessing non-human-edible food sources and the environmental benefits of grazing systems such as biodiversity benefits (Herzog et al., 2018; Keeling et al., 2019), dairy farming that minimizes external inputs and (imported) concentrate supplements could reduce environmental impacts (Müller et al., 2018; Schader et al., 2015).

Sustainable food systems, however, involve many facets and trade-offs – more so now than when the concept of sustainability was first introduced with a strong anthropocentric focus on human well-being and economy (Arcari, 2017; Washington et al., 2017). In particular, sustainable food systems are increasingly understood to encompass short- and long-term improvements in the environment and the well-being of human communities *as well as* considerations to the human-induced animal welfare impacts (Broom, 2022). This development is driven by a multitude of factors – from strong interrelations between improvements in animal welfare and improvements in the social-ecological system, as reflected in the recent development of frameworks such as One Health and One Welfare (Bozzo et al., 2021; Pinillos et al., 2016; Verniers & Brels, 2021; WHO et al., 2022); to recent scientific insights on cognitive, emotional and social capacities of animals, and the ethical implications of these insights (e.g., De Waal, 2016; Korsgaard, 2018; Nussbaum, 2023; Spiller et al., 2020), and increasing animal welfare awareness among consumers in wealthier countries (Eurobarometer 2023; Koik et al., 2019; Regan & Kenny, 2022).

In light of this, profound animal welfare improvements are crucial to

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maintaining public acceptance (Bolton & von Keyserlingk, 2021; Weary & Von Keyserlingk, 2017) and consumer demand, especially in the face of an increasing market uptake and rapid enhancement of dairy alternatives. Such improvements in animal welfare can lead to increased costs for farmers arising from higher investments in building, machinery, and labor time (Gazzarin et al., 2020; Spiller et al., 2020). Hence, implementation of animal welfare improvements depends on consumer preferences and their willingness to pay (WTP) (Grethe, 2017). Since animal welfare characteristics are usually not visible or verifiable by consumers without substantial efforts due to the absence of accessible information, the market does not fully reflect consumer preferences and WTP for animal welfare improvements (Lizin et al., 2022). Although there may be a preference on the part of consumers for such characteristics, this preference is not reflected in real markets in the absence of credibly conveyed information. However, providing such credible information along with the product (e.g., in the form of labels) can change consumers' purchase decisions if preferences for the corresponding characteristics exist (Lizin et al., 2022). For this reason, we see increasing efforts by various producer associations, label associations, retail trade groups, and individual farmer groups to draw attention to the origin and production method of their products by means of appropriate product labels. However, only in niche areas are there any labels or other information on the direct animal welfare-related properties of dairy products in the Swiss market. Therefore, no conclusions can be drawn based on existing markets in Switzerland – and beyond – on how accepted or preferred certain animal welfare relevant production methods are and how the purchase decision of consumers would turn out if corresponding information was available.

In a discrete choice experiment (DCE), similar to real markets, consumers choose among products described in terms of combinations of different product-relevant attributes. This description strategy allows DCEs to mimic a real-life purchase situation, with the advantage that the DCE may include information and/or product attributes not visible in actual markets (Lizin et al., 2022; Wang et al., 2019). For these reasons, we conducted a DCE to assess Swiss consumers' preferences for butter and milk,[1] and explored whether they are willing to contribute monetarily to improvements in animal welfare. Several studies have estimated WTP for animal welfare improvements in dairy production. Bir et al. (2020) estimated a WTP for grazing, antibiotics bans and, to a lesser extent, for analgesia during dehorning in the US. These findings have been corroborated in Japan (Kitano et al., 2022). Wolf and Tonsor (2017)'s study in the US confirmed consumers' WTP for outdoor access, hoof health, and clean facilities. Boaitey et al. (2022) found a WTP for dairy production systems with more intensive contact between cow and calf, and – similarly to Bir et al. (2020) – a positive WTP for pain elimination during dehorning. In Italy, Cavalletti et al. (2023) found a positive WTP for better animal welfare conditions in local mountain cheese production, although to a lesser extent compared to the WTP for mountain ecosystem services. Markova-Nenova and Wätzold (2017), for Germany, and Tavárez and Álamo (2021), for Puerto Rico, estimated a high WTP for animal welfare, exceeding WTP for environmental or local attributes. No previous study focusing on Switzerland has explored WTP for welfare-related attributes and only few have explored Swiss consumers' attitudes and perceptions with respect to animal welfare practices. Using purchase simulations, Stolz et al. (2011) found Swiss organic milk buyers, compared to conventional milk buyers, preferred pasture-raised milk, but the study did not assess WTP explicitly. Ammann et al. (2023) surveyed Swiss consumers on their perceived importance of animal welfare vis-à-vis three other policy goals – domestic production; food prices; and farmer's income. Their results revealed, on average, a preference for animal welfare compared to all three of the alternative policy goals. Finally, Ammann et al. (2024) found a consumer preference for animal welfare in meat and dairy consumption compared to organic production, the carbon footprint or other environmental product characteristics.

Switzerland is an illustrative case for sustainable dairy production with its high, distributed level of economic prosperity and overall competitive animal welfare standards (API, n.d.). The country has been a pioneer in animal welfare improvements by, for example, banning the use of cages for laying hens (Nista et al., 2020). Moreover, much of its land is mountainous and is not or only conditionally suitable for plant-based food production. Instead, Switzerland's geography and climate are well suited to extensive, grassland-based milk production (MISTA, 2022), which is extensively supported by government programs promoting regular outdoor exercise and grazing. As a result, about 87 % of dairy cows are regularly grazing during the vegetation period (BLW, 2022).

Yet, critical animal welfare issues remain in Switzerland. Drawing on an animal welfare classification of the Swiss dairy industry,[2] our study focuses on two improvements: generous loose housing versus tethered housing, and the killing of the animals on their farm of origin versus in the slaughterhouse. First, tethered housing is a weakness of Switzerland's dairy industry by international comparison (Boessinger & Hoffet, 2019) as it severely restricts animal movement and social interaction, affecting two crucial animal welfare dimensions – natural living and affective states (Fraser et al., 1997; Fraser, 2008). Nevertheless, in the animal welfare classification experts noted loose housing is clearly preferable to tethered housing only if it offers sufficient space for movement and escape possibilities for the animals. We considered these insights in our DCE by explicitly referring to the housing improvement to a loose housing system with *generous* space available for the animals (cf. Section 2.1.1). The second dimension, farm killing, is a recent development in Switzerland and has garnered attention by the media and broader society (e.g., BioAktuell, n.d.; Hotz, 2022; Troxler, 2023). Avoiding transport and a stay in the slaughterhouse have comparative welfare advantages, such as reduced stress and physical injuries (Probst et al., 2017).

Several studies using DCEs have addressed housing improvements and farm killing. Carlsson et al. (2005) found that consumers in Sweden show a higher WTP for loose housing (over tethered housing) than for other features such as a longer cow-calf contact duration after birth. A 2019 cross-national DCE study, however, showed no positive WTP for more animal welfare-friendly housing systems (Waldrop & Roosen, 2021). Markova-Nenova and Wätzold (2017) found a higher WTP for loose housing systems with pasture access among consumers in Germany compared to other factors, such as biodiversity protection, farm support and products' local origin. Regarding meat products, Carlsson et al. (2005, 2007) found a relatively low WTP among Swedish consumers for slaughter in a mobile abattoir (i.e., without transport to and killing in the slaughterhouse) compared to WTP for a ban of genetically modified fodder, which varied depending on the animal – with a negative WTP for chicken, and a positive WTP for cattle and pigs.

To be able to contextualize and contrast consumers' WTP for animal welfare improvements with other important decision factors, we included additional product attributes relevant to dairy consumption in Switzerland – organic production, product origin, and greenhouse gas (GHG) emissions reductions (for more details on their relevance and specification, see Section 2.1.1). Whereas for the former two, we only

[1] Within the context of dairy production, we explicitly focused the consumer survey on products based on *cow's* milk, because, from among the different types of milk, cow's milk is the most important in terms of number of heads and volume. In 2021, Switzerland hosted approximately 546,000 dairy cows, 35,000 dairy goats and 14,000 dairy sheep. In terms of volume, in 2021, cows produced 3,812,000 tons; goats and sheep combined 29,000 tons; and water buffalo less than 2,000 tons (MISTA, 2022).

[2] The animal welfare classification was conducted by the leading author of this paper based on literature research and expert interviews prior to designing the consumer survey and DCE (cf. Section 2.1.1).

examined consumers' WTP and compared it with their WTP for improving animal welfare, for reducing GHG emissions, we confronted consumers with an explicit trade-off with animal welfare. GHG reductions on farms can be accompanied by positive, negative or neutral animal welfare impacts, depending on the type of measures taken to reduce emissions (Llonch et al., 2017). While higher livestock productivity can lower GHG emission intensity of production (Herzog et al., 2018), it often leads to negative animal welfare impacts due to increased strain on cows – namely, an increase in cows' average milk production performance, leading to increased metabolic, cardiac, and respiratory output potentially causing adverse health effects (Bolton & Von Keyserlingk, 2021; Llonch et al., 2017; Oltenacu & Broom, 2010).[3] To our knowledge, no prior DCE on dairy products has investigated how consumers perceive GHG reductions that go along with animal welfare impairments. Our DCE fills this gap.

Our experiment explores WTP through two dairy products – milk and butter. We have chosen these two products based on previous literature showing varying levels of WTP across dairy products with distinct degrees of processing. Widmar and Ortega (2014)'s DCE regarding yogurt and ice cream found "statistically significant differences in WTP across dairy products" for animal welfare attributes (ibid., p. 386). Moreover, Olynk and Ortega (2013)'s study looking at yogurt and ice cream in the US shows that consumers' preference structure and WTP estimates for different animal welfare attributes – pasture grazing, antibiotics bans, and growth hormone bans – can shift between the two products. Stolz et al. (2011) found a significant relationship between Swiss consumers' attitudes toward cow grazing and their certified organic milk purchases, but not for more processed yogurt, which they attributed to the degree of processing (less for milk; more for yogurt). We conducted separate DCEs for milk and butter to explore these potential differences. Milk was chosen for its low degree of processing and butter for its uniform variations compared to the diverse range and prices of cheese and yogurt products and for its high consumer demand. Additionally, dairy products with similarly small product variations, such as cream or quark, are purchased by proportionately fewer consumers and animal welfare preferences have, to our best knowledge, not been investigated via the butter market.

In short, this paper investigated whether Swiss consumers are willing to contribute monetarily to animal welfare improvements through an increase in prices of butter or milk. Specifically, using a DCE (N = 986), we investigated preferences for two animal welfare improvements in the dairy industry – loose housing and farm killing – as well as for organic production, origin of product, and GHG reductions. In doing so, we explicitly assessed how consumers perceive GHG reductions that are accompanied by animal welfare impairments, which has not been explored for dairy products previously.

In the following sections, we first outline our methodological approach (Section 2), followed by the presentation and discussion of the main results of the consumer survey (Sections 3 and 4). Section 5 concludes the paper.

2. Materials and methods

2.1. Discrete choice experiment

A DCE is a tool allowing researchers to explore whether and to what degree specific product "attributes" influence consumer preferences, and provide insights into consumer choice decisions. Consumers are presented with different choice scenarios including several product alternatives with varying attributes and choose the most preferred alternative in each scenario. In the background, a DCE assumes that a consumer's utility associated with a good or service is the sum of marginal utilities provided by each attribute characterizing the corresponding good. Consequently, in a DCE, when faced with the choice among a number of goods, respondents would choose the good with the attributes that provided the highest utility all together (Lizin et al., 2022; Manski, 1977; McFadden, 1973). By analyzing respondents' stated decisions, researchers can infer the marginal willingness to pay (WTP) for each attribute – e.g., for animal welfare practices and for reductions in GHG, separately.

In what follows, we first explain attributes and levels of our DCE, followed by a description of the experimental design, preparation and implementation.

2.1.1. Attributes and levels

The selected attributes of our DCE mainly reflect the central research questions of our study: the assessment of the WTP for animal welfare improvements and the investigation of consumer preferences regarding GHG emission reductions that compromise animal welfare. Our choice situation and attributes *explicitly* reflect a *hypothetical* consumption scenario, since product information on most attributes is not available in real markets in Switzerland. Yet we aimed for feasible combinations of attributes by (i) deriving them based on insights from relevant literature and expert interviews, and in light of the particular context of the Swiss dairy industry; (ii) including sustainability-relevant attributes known to be important for dairy products and for the Swiss context; and (iii) choosing the attributes' levels in view of the particular conditions present in Switzerland. To derive and characterize the attributes relevant to animal welfare and for the particular context of the Swiss dairy industry, we used insights from interviews we carried out with five experts in the fields of livestock science, veterinary medicine, ethology, and animal welfare.[4] For this, we also considered the relevance of attributes in light of the current social-political discussion and recent developments in dairy production in Switzerland. For the potential tradeoff between animal welfare and climate improvements, we included a separate attribute aimed to specifically reflect opposing effects in these two areas. To allow for a comparison of consumers' WTP for animal welfare improvements with other important decision factors, we selected additional attributes known to be relevant to dairy consumers from previous studies exploring WTP for animal welfare in dairy production; this led to the inclusion of the attributes *production standards* and *product origin*. Table 1 lists all six attributes and their corresponding levels. In the following, the individual attributes are briefly outlined.

In Table 1, the first two attributes describe animal welfare improvements. The first attribute, *Housing*, is relevant in the Swiss context because more than 40% of Swiss farms keep their cattle tethered (Boessinger & Hoffet, 2019; SRG Deutschschweiz, 2022; SRF 2022). Experts interviewed prior to the DCE identified housing conditions as an important animal welfare issue in Switzerland. Similar to work by Carlsson et al. (2005) and Markova-Nenova and Wätzold (2017), we distinguished between tethered and loose housing. However, in contrast to their work, we explicitly described loose housing as keeping cattle in a barn with generous, free and ample space for movement because of the potential animal welfare problems associated with confined loose housing.

The second attribute, *Transport and slaughter*, has been discussed

[3] Other health issues associated with high-performance breeding are found in declining fertility (Farstad, 2018) and longevity of cows (Oltenacu & Broom, 2010).

[4] The interviews were carried out between the end of June and mid-October 2022. Two of the experts were men, three were women. The interviews lasted from 41 min to close to two and a half hours. The leading author of this paper conducted the interviews and performed the subsequent transcription and content analysis. The interviews' main purpose was to develop an animal welfare classification of the Swiss dairy industry. This classification was used both for a stand-alone analysis as part of the master's thesis of the first author (see acknowledgements), and to derive and characterize questions for the consumer survey (see section 2.1.3 below) and attributes of this DCE.

Table 1
Attributes and levels of the discrete choice experiment.

Attribute	*Description*	*Level*
Explicit animal welfare considerations		
Housing	Way of housing the animals in the barn	0: Tie stall 1: Loose housing with generous space
Transport and slaughter	Mode of transport and killing for slaughter	0: Live transport to the slaughterhouse and professional killing in the slaughterhouse 1: Professional killing on the farm without live transport to the slaughterhouse
Further sustainability considerations		
Production standards	Milk production according to legal standard (conventional) or organic regulations in Switzerland	0: Conventional production 1: Organic production
Greenhouse gas emissions	Reductions of greenhouse gas emissions at the farm level and their impact on animal welfare	0: No reductions 1: Greenhouse gas reductions with negative animal welfare impacts 2: Greenhouse gas reductions without compromising animal welfare
Product origin	Location of the creation of the product	0: Production outside the region but within Switzerland 1: Production within the region (20 km)
Price	Percentage price increase compared to the current purchase price stated by participants	0: +0% (no price increase) 1: +20 % (twenty percent price increase) 2: +40 % (forty percent price increase)

recently in Switzerland (e.g., BioAktuell, n.d.; Hotz, 2022; Troxler, 2023), and was classified as an important potential animal welfare improvement by experts because of lower stress levels and injury risks associated with this type of slaughter. We slightly adapted the formulation in Carlsson et al. (2007) and included the word *professional* to reflect the highly regulated form of both types of slaughter in Switzerland, avoiding the impression that farm killing is an unprofessionally or unsafely performed form of slaughter.

The third attribute, *Production standards,* is motivated by the relevance of organic standards in consumer food choices – organic drinking milk accounts for 27% of the total drinking milk market in Switzerland (BioSuisse, n.d.). We classified it into two categories: conventional – reflecting production following legal standards –, and organic – reflecting stricter animal welfare requirements (especially regular grazing) as well as aspects that are not primarily relevant to animal welfare (e.g., feeding of organic feed). Importantly, the requirements on animal housing and slaughtering mentioned above do not differ across levels of the attribute *Production standards*, as corresponding regulations are similar in conventional and organic production. We pointed out this aspect to respondents in the description of the attribute.

The fourth attribute, *Greenhouse gas emissions*, has been included due to its increasing relevance in the discussion on sustainable milk production (e.g., Broom, 2021; Caro et al., 2014; Herzog et al., 2018; Llonch et al., 2017) and refers to measures that reduce GHG emissions at the *farm* level and their associated impact on animal welfare. We included three different levels: no reductions; reductions with negative animal welfare impacts; and reductions without compromising animal welfare. For the latter two, a brief example was provided in the introductory text to the DCE based on Llonch et al. (2017) as well as on the statements from the previously conducted expert interviews (see Supplementary Material 1). Our approach of combining GHG reduction with and without reduction of animal welfare in an unlabelled design has the advantage of providing suggestions on how consumers deal with these particular conflicting goals that are existent in agricultural practice. It furthermore sheds light on the particular level of utility arising from the reduction of GHG when combined or not combined with animal welfare impairments.

The fifth attribute, *Product origin*, was included due to consumers' preference for local production, evident in the number of regional labels seen in the Swiss food market (Pusch, n.d.). As self-sufficiency for dairy products is particularly high in Switzerland,[5] and as the focus of this study was on domestic production, we made no distinction between domestic and foreign products, but rather between regions within Switzerland – similar to Markova-Nenova and Wätzold (2017) and Kitano et al. (2022).

Lastly, the *Price* of the product varied according to three levels. The first level corresponded to the respondent's current purchase price; the second and third level represented an increase of 20 % and 40 % compared to this price. These increments were used to allow for enough variation, while avoiding unrealistic price ranges. To determine respondent's current purchase price, respondents were asked earlier in the questionnaire about the price they usually pay for the respective dairy product – milk or butter. This information was subsequently used to translate the price attribute into Swiss Francs in the analysis (Rose et al., 2008).[6] The definition of the price attribute as a relative increase compared to the reference value of the current purchase price was chosen to relate the prices more closely to actual market prices of participants, since prices for dairy products sometimes differ significantly between purchase channels in Switzerland.

All attributes were described to the participants in brief text snippets prior to the DCE. Respondents were then asked to choose the product with the characteristics that they would favor most in a real purchase situation, while assuming that their total consumption of the respective product stays as it currently is and that 100% of the product (milk or butter) would be produced under these conditions (and which they specified in a previous questionnaire item). In order to reduce the so-called hypothetical bias that may lead to unrealistically high willingness-to-pay estimates in choice experimental studies, participants were encouraged in the introductory text to put themselves into a real-life purchase situation and consider their budget for dairy products (Lusk & Schroeder, 2004; Tonsor & Shupp, 2011).

2.1.2. Experimental design

For the experimental design, a fractional factorial D_p-efficient design was used (Rose & Bliemer, 2009) with two unlabelled generic alternatives and a no-buy option. The product alternatives were formulated in generic terms (milk A, milk B, or butter A, butter B). By doing so, we intended to exclude the effect of specific product types on consumer choice. We did not specify a status quo alternative because a clear reference product does not exist for dairy products in Switzerland, due to the lack of information on individual attributes in real markets (type of housing and killing as well as GHG reduction measures) and differences in practice between farms. The no-buy option reflects a realistic market

[5] For drinking milk, for example, the domestic production share is more than 90% of the total consumption (BLW, 2022).

[6] Train and Wilson (2008) argue that this strategy, known as 'pivoting' – in which the price pivots around real market values – can introduce endogeneity because "unobserved factors in the revealed preference setting can be expected to carry over to the stated preference choice" (p. 192). Louviere (2006) points out potential efficiency problems of DCE design in this context. Pivoting, however, is associated with numerous practical advantages (Rose et al., 2008; cf. also Louviere 2006 and Train & Wilson 2006) and is commonly implemented in the literature (e.g., Hensher, 2004; Caussade et al., 2005; Hensher, 2008; Thiene et al., 2017; Bansal & Daziano, 2018; Schulze et al., 2021). Furthermore, the described problem may also exist for non-pivotalized DCEs once labels are used for the product alternatives (Bradley & Daly, 1993; Train & Wilson 2008). In the case of the present study, pivoting was performed only for the price parameter.

situation and avoids forcing respondents to state a choice, thereby following conventional economic consumer theory and avoiding external validity issues (Dhar & Simonson, 2003; Louviere & Lancsar, 2009; Risius & Hamm, 2017; Schulze et al., 2021).

We created the experimental design using the Ngene software (Ngene 1.2). The multinomial logit model with priors 0 or close to 0 (0, 0.000001 and −0.000001, respectively) was used as underlying model of the choice experiment, as we lacked prior empirical information on the role of the attributes in question regarding Swiss dairy products (Ngene, 2018). To reduce the number of choice sets, the design was divided into four blocks with six choice sets per block (i.e., a total of 24 choice sets). Each participant was thus presented with six choice sets. The D-error of the final design was 0.081679.

2.1.3. Questionnaire design, translation, and pretest

The questionnaire, including the DCE, was programmed with Qualtrics (version December 2022). It was designed to analyze how consumers perceive the topic of animal welfare in dairy production in Switzerland, with the DCE as one central component delivering information on the role of animal welfare in consumer choice decisions. The broader questionnaire included sets of questions gathering knowledge and attitudes, sociodemographic characteristics, and dietary and consumption habits (see Fig. 1 for an overview of the questionnaire design; the full questionnaire is in Supplementary Material 1).[7]

To identify errors, ambiguities, or inconsistencies, the survey was pretested in several versions by ten people, including two experts in animal welfare in the dairy industry (Blair et al., 2013; Brace, 2018; Schnell, 2019). The German version of the questionnaire was translated into French by a researcher and native French speaker and then reviewed by the authors. The six choice sets were presented in randomized order based on Weber (2021). The survey design was identical for those assigned to the milk and the butter experiments, with the only differences being in the introductory questions, introductory texts and product names, which were adapted to the corresponding dairy product (milk or butter). Fig. 2 exemplifies the choice sets presented to the milk sample.

2.2. Data collection

Respondents were recruited between December 12 and 24, 2022, through Bilendi – a panel service company. A total of 2471 participants entered the survey. After screenouts[8], elimination of speeders[9], bots and duplicates, and a comprehensive quality check, we obtained 986 observations for our analysis. Respondents are residents in the German- and French-speaking regions,[10] older than 17 and younger than 75, who purchase dairy products at least monthly. Quotas were set for age, gender and region of residence (crossed) as well as educational level (uncrossed) based on the *total* population characteristics recorded by the Swiss Federal Statistical Office (BfS). Notice that precise demographic data on Swiss *dairy consumers* are unavailable but 97% of Swiss population aged 14+ are consumers of staple foods and dairy products (WEMF, 2015). Our survey data collection meets the ethical standards of the University of Basel, Switzerland.

2.3. Descriptive statistics

The sample consists of 489 participants in the milk DCE and 497 in the butter DCE. Table 2 summarizes sociodemographic characteristics of the whole sample. Additional sociodemographic and consumption characteristics can be found in Supplementary Material 2, Table S1. Pearson's chi-square tests comparing the distribution of sociodemographic characteristics (Field, 2013) between the milk and the butter DCE samples showed no significant differences for age, education, language region, income level, area of residence (rural/urban), living situation (e.g., single household), or number of children in the household ($p > 0.05$). However, a statistically significant difference was observed for gender ($p = 0.02$), with men slightly overrepresented in the milk group (53.2% to 46.8%) and women slightly overrepresented in the butter group (54.1% to 45.9%). The difference in gender proportion (between the milk and butter groups) does not affect our analyses of the main research questions, as analyses were conducted either on each sample separately or on a pooled sample. However, for comparing WTP between milk and butter samples, the gender proportion difference is potentially relevant, and we therefore carefully discuss it later.

2.4. Econometric model and analysis

A summary of the theoretical background to the DCE models used in our study is provided in Supplementary Material 3. We analyzed the data with a conditional logit model (CLM) and two random parameter logit models (RPLM) – two alternative modeling approaches for individuals' choice probabilities. The two approaches differ in their assumptions about the nature of the error term and the heterogeneity in preferences. The CLM assumes homogeneity in preferences – i.e. that every respondent trades the attributes in the DCE in the same way – and that the error term reflects pure randomness – i.e. that all systematic behavior is captured by the variables included in the specification. In contrast, the RLPM assumes heterogeneity in preferences – i.e. that each respondent trades the attributes in his/her own unique way – and that the error term reflects, in addition to pure randomness, a systematic behavior that can be modelled through a combination of distributional assumptions on the preference parameters and their correlations (Hensher & Greene, 2003; McFadden & Train, 2000; Train, 2009). After estimating the effects in question, we assessed the models' goodness of fit and proceeded with the result interpretation of the statistically preferred ones.

Since the price increase was presented to the participants as a percentage increase compared to their current purchase price, a transformation of the price variable was performed to calculate the price increase in absolute terms. The RPLM was modeled once with a fixed price parameter and once with a normally distributed, random price parameter. The parameters for the remaining attributes were modeled as random in both RPLMs, and normal distributions were assumed. For simulation, the maximum simulated likelihood estimation (MSLE) method was used (Hensher & Greene, 2003; McFadden & Train, 2000; Train, 2009). For the calculation of the RPLMs, the user-written module Hole (2007a) was used.

Marginal WTPs were estimated by using the estimated parameters to calculate the following ratios

$$\mathrm{mWTP}_{\mathrm{A}i} = -\beta_{\mathrm{A}i}/\beta_{\mathrm{Aprice}},$$

[7] For another part of the questionnaire – the knowledge questions and part of the attitude questions – a smaller, independent publication of practical relevance was published in a Swiss magazine independently of the results of the DCE (available at: maz_2023_4.pdf (kagfreiland.ch), there page 3–5). However, to incorporate knowledge effects was not a focus of the DCE design and is not part of the present publication.

[8] That is, participants residing in Ticino; participants under 18 as well as over 74 years of age; participants with no responsibility for household purchases; and participants who purchase dairy products less than once per month and/or do not purchase milk or butter.

[9] "[S]peeding – responding too fast to give much thought to answers – is likely to arise when respondents are motivated primarily to finish the questionnaire rather than provide careful and accurate responses." (Zhang & Conrad 2014, p. 127). Participants who took less than 50% of the median time to complete the questionnaire were flagged as speeders.

[10] These two regions cover about 90 percent of the Swiss population.

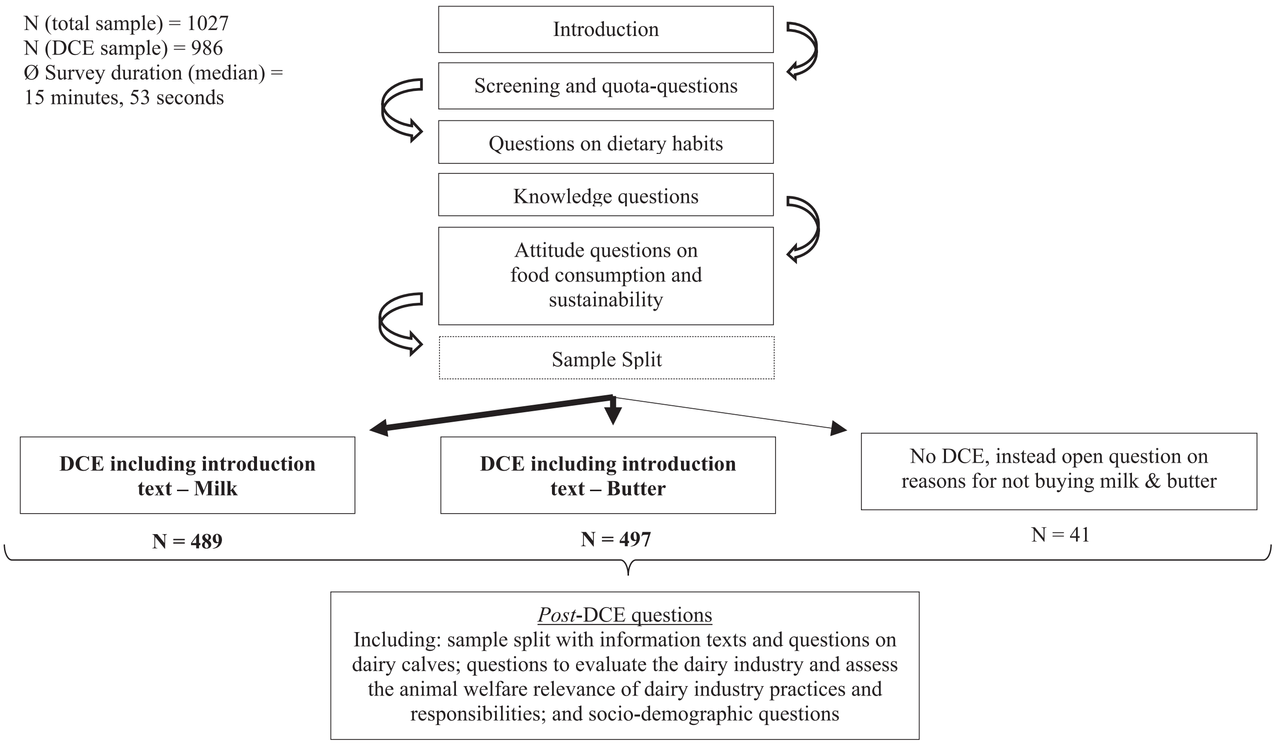


Fig. 1. Structure and flow of the questionnaire.

where β_{Ai} stands for the coefficient of the respective attribute A_i and β_{Aprice} stands for the coefficient of the price attribute (Lancsar et al., 2017).[11] For the calculation of the WTP and the associated confidence intervals, the user-written module Hole (2007b) was used.

3. Results

The parameter estimates from the three calculated models – the CLM (model 1), the RPLM with fixed price parameter (model 2) and the RPLM with normally distributed price parameter (model 3) – are shown in Table 3 for the milk sample and Table 4 for the butter sample. The significance of the standard deviations for several parameters of both samples indicates heterogeneity in preferences and therefore the preferability of the RPLM models over the CLM model (Martinez-Cruz & Nuñez, 2021; Ortiz et al., 2023; Hensher et al., 2015). This is also evident from the Akaike information criteria (AIC) and the Schwarz Bayesian information criteria (BIC) values, which are lower for the two RPLM models than for the CLM, indicating a better model fit. According to both AIC and BIC, the RPLM with normally distributed price parameter shows the best model fit. Results from the RPLMs with a normally distributed price coefficients also result in the lowest WTP estimates (see below), which – in addition to the better model fit – speaks for the use of this model in answering our research questions, since there is a tendency for consumers to overestimate their WTP in DCEs (Wolf & Tonsor, 2017) and therefore the more conservative model estimate of WTP may be considered preferable in terms of informing stakeholder decisions (Martinez-Cruz & Nuñez, 2021). For these reasons, for both products we discuss the results of the RPLM with normally distributed price parameter to answer the research questions (right column in Tables 5 and 6).

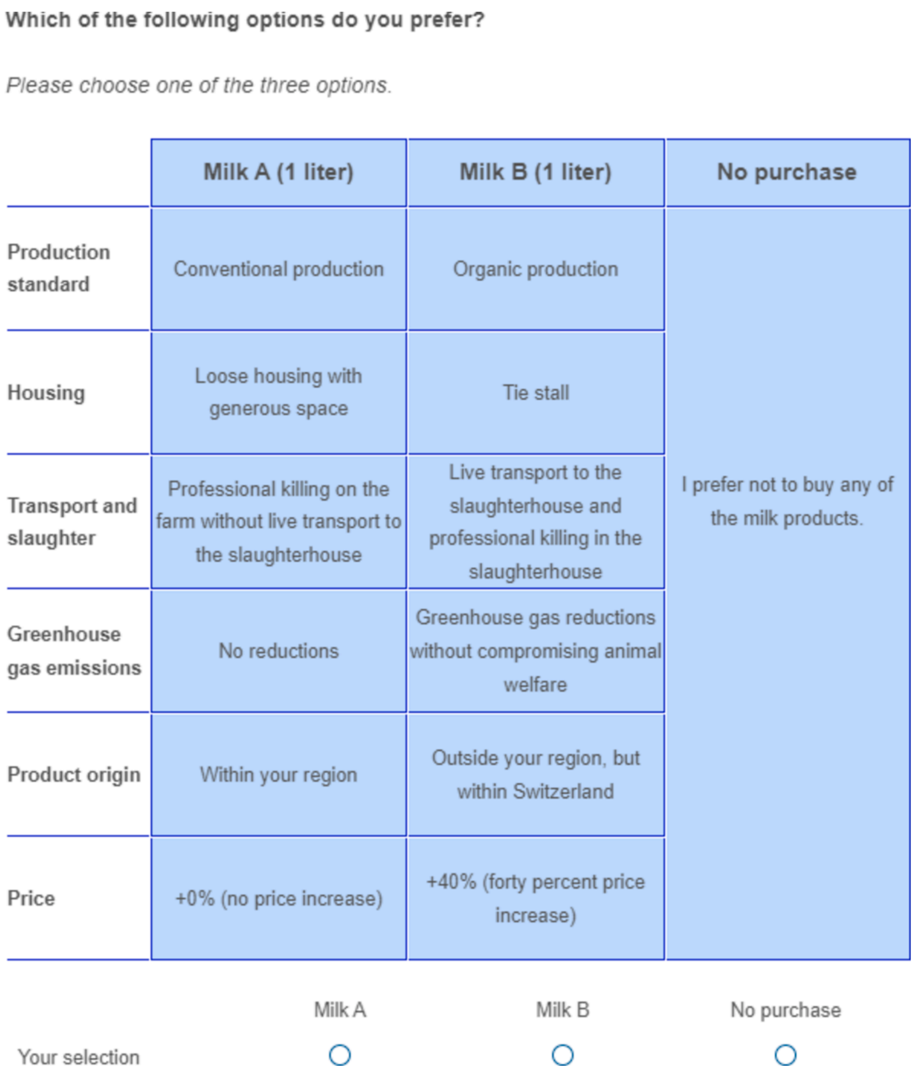
We performed various robustness checks through estimation of a number of alternative RPLM specifications, which we report in Supplementary Material 4.[12,13] In particular, we estimated a RPLM that assumes normally distributed and correlated preference parameters for both the milk and butter samples. In this way, we explored potential correlations in preferences – for example, consumers positively valuing reductions in GHG emissions may also positively value more humane slaughtering conditions. These RPLM specifications with correlated parameters resulted in similar significance values and directions for both the attribute coefficients and WTP for both the milk and butter samples (see Supplementary Material 4, Tables S6-S13). Although a few correlation parameters turned out significant, the model fit according to the Bayesian Information Criterion (BIC) was worse for the RPLM with correlated parameters compared to the RPLM with uncorrelated parameters.[14] Furthermore, the average WTP turned out higher for the RPLM with correlated parameters. As RPLM with correlated parameters did not yield an improvement in statistical fit and as hypothetical choice experiments tend to overestimate WTP (Wolf & Tonsor, 2017) – and we want to be conservative with our estimates of stated WTP –, we kept the

[11] Lancsar et al. (2017) argue that calculating WTP for RPLMs with a normally distributed price parameter can be fraught with problems because the distribution for marginal WTP lacks a well-defined mean. However, since in the case of this study the calculated WTP does not differ significantly between the three models (cf. Section 3), we infer that estimates in this study are sufficiently robust to differences in model specification as well as with respect to the normal distribution assumption for the price parameter.

[12] We also estimated the model with effect-coded variables, which, however, did not change the relative statistical performance. Throughout the article, we use the dummy-coded models and coefficient estimates.

[13] We thank the two anonymous reviewers for their helpful comments and suggestions on this.

[14] The AIC and BIC are both criteria that assess statistical fit of specifications by penalizing for the number of estimated parameters. BIC is more stringent than AIC. BIC penalizes more for each extra parameter, with larger penalizations as the sample size increases. Consequently, BIC picks more parsimonious models than AIC as sample size increases. Consistently, BIC has been shown to overperform AIC as sample size increases, and BIC is recommended over AIC in the absence of a strong theory or prior about the appropriate model (Raffalovich et al., 2008). This is why we decided to base our model selection on the BIC when BIC and AIC have not suggested the same model as the best fit.


Which of the following options do you prefer?

Please choose one of the three options.

	Milk A (1 liter)	Milk B (1 liter)	No purchase
Production standard	Conventional production	Organic production	I prefer not to buy any of the milk products.
Housing	Loose housing with generous space	Tie stall	
Transport and slaughter	Professional killing on the farm without live transport to the slaughterhouse	Live transport to the slaughterhouse and professional killing in the slaughterhouse	
Greenhouse gas emissions	No reductions	Greenhouse gas reductions without compromising animal welfare	
Product origin	Within your region	Outside your region, but within Switzerland	
Price	+0% (no price increase)	+40% (forty percent price increase)	

	Milk A	Milk B	No purchase
Your selection	○	○	○

Fig. 2. Example of a choice set from the discrete choice experiment for the product milk (translated by the authors from the original German questionnaire version). Each DCE participant was presented with a total of six such choice sets in randomized order.

RPLM specifications with uncorrelated parameters in the main manuscript.

3.1. Preferences and willingness to pay for the milk sample

As reported in Table 3, which refers to specifications on the sample presented to changes in milk price, all parameters in the RPLM with normally distributed, uncorrelated parameters are statistically significant, with exception of the parameter associated to the origin of the product ('Local Origin'). Thus, consumers show no clear preference for milk produced regionally (specified as a radius of 20 km) compared to milk produced in Switzerland but not regionally. The coefficient for price is negative, as expected from economic theory; so is the coefficient for the 'No buy'-option, i.e., this is not preferred by consumers compared to purchasing either milk product. The attributes 'Organic', 'Loose Housing', 'Farm Killing' and 'GHG 2' show positive coefficients. Therefore, consumers indicate a preference for i) organic compared to conventional milk production; ii) keeping animals in a large loose housing system compared to tethering; iii) killing animals on farms compared to transporting and killing them in the slaughterhouse; and iv) reducing GHG emissions in production *without* compromising animal welfare. The negative sign of the coefficient for attribute 'GHG 1' indicates a rejection of production-side GHG reduction measures that compromise animal welfare.

The (marginal) WTP for the respective attributes is shown in Table 5. Apart from the "No buy"-option, for which the WTP values are not relevant in this case,[15] the values differ slightly but tend to be similar across the three models. There is a significant and positive WTP for both types of animal welfare improvement included in the DCE. The calculated marginal WTP for farm killing compared to slaughterhouse killing is 26 centimes for 1 L of milk; for keeping the animals in a spacious loose house rather than in tethering, the WTP is 72 centimes. However, it must be considered that the reference category for loose housing is tethering and thus does not represent the current market standard, as it does in the case for farm killing with the reference category of slaughterhouse killing. While the latter is the standard throughout Switzerland, tethering is not the standard, but practiced by slightly less than half of Swiss dairy farms (SRG, 2022; SRF 2022).

The highest WTP is found for the two animal welfare improvements. The WTP for organic production and the reduction of GHG emissions in production (without animal welfare impairments) is slightly lower than for farm slaughter, at 22 centimes and 20 centimes respectively, but is still positive and significant. For local origin, there is only a slightly positive WTP of 9 centimes (in models 1 and 2, the corresponding WTP

[15] The negative sign simply indicates that the "No buy"-option is not preferred by consumers.

Table 2
Sociodemographic characteristics of the DCE sample (milk and butter combined) and population.

Sociodemographic characteristics		Sample		Population
Item	Category	N	Share of sample	Share of total population
Age	18–34	277	28,1%	28,7%
	35–54	388	39,4%	39,0%
	55–74	321	32,6%	32,2%
Education	low	123	12,5%	14,4%
	medium	475	48,2%	46,1%
	high	388	39,4%	39,6%
Gender	Male	488	49,5%	50,2%
	Female	498	50,5%	49,8%
Region of residence	Espace Mittelland	226	22,9%	22,6%
	Northwestern Switzerland	141	14,3%	14,2%
	Eastern Switzerland	145	14,7%	14,4%
	Région lémanique	194	19,7%	20,0%
	Central Switzerland	99	10,0%	10,0%
	Zurich	181	18,4%	18,8%

Sources: Data from BfS (2022b, 2022c) as well as own calculations. For the formation on shares for the educational level classified by low/medium/high for the population of 18–74-year-olds, data were requested directly from the Federal Statistical Office (BfS), Education Unit, due to a lack of public availability. The above percentages for the population regarding the education level are taken from the data provided by an employee of the BfS.

Table 3
Conditional Logit and Random Parameter Logit Model specifications for the milk sample.

Milk sample	Model 1: Conditional Logit Model (fixed parameters)				Model 2: Random Parameter Logit Model (price fixed, others random)				Model 3: Random Parameter Logit Model (all random)			
	Coefficient	Std. err.	[95 % conf. interval]		Coefficient	Std. err.	[95 % conf. interval]		Coefficient	Std. err.	[95 % conf. interval]	
Mean Estimates												
No buy option	−0.382***	0.081	−0.540	−0.225	−1.263***	0.175	−1.607	−0.921	−1.154***	0.172	−1.491	−0.816
Organic[a]	0.246***	0.045	0.158	0.333	0.289***	0.063	0.165	0.414	0.319***	0.071	0.179	0.459
Loose Housing[b]	0.782***	0.046	0.692	0.871	0.961***	0.071	0.822	1.101	1.066***	0.081	0.908	1.224
Farm Slaughter[c]	0.258***	0.045	0.170	0.345	0.319***	0.055	0.211	0.427	0.375***	0.062	0.252	0.497
GHG 1[d#]	−0.195**	0.062	−0.316	−0.074	−0.273**	0.079	−0.428	−0.119	−0.266**	0.088	−0.438	−0.094
GHG 2[d§]	0.200**	0.060	0.082	0.318	0.258***	0.072	0.117	0.399	0.299***	0.082	0.137	0.461
Local Origin[e]	0.062	0.044	−0.025	0.149	0.089	0.057	−0.023	0.200	0.126	0.064	−0.000	0.251
Price	−0.823***	0.076	−0.972	−0.674	−1.035***	0.094	−1.219	−0.852	−1.471***	0.146	−1.757	−1.186
Standard Deviation of Parameters												
No buy option					2.133***	0.150	1.840	2.426	2.162***	0.157	1.854	2.470
Organic[a]					0.743***	0.100	0.546	0.939	0.920***	0.105	0.713	1.127
Loose Housing[b]					0.791***	0.094	0.607	0.975	0.918***	0.108	0.707	1.129
Farm Slaughter[c]					−0.387**	0.129	−0.640	−0.135	−0.508***	0.115	−0.734	−0.282
GHG 1[d#]					0.332	0.217	−0.0943	0.758	0.491*	0.193	0.113	0.869
GHG 2[d§]					0.174	0.213	−0.245	0.592	0.265	0.157	−0.043	0.574
Local Origin[e]					0.219	0.142	−0.060	0.498	0.304*	0.133	0.043	0.566
Price									1.640***	0.190	1.268	2.014
Observations and Model Characteristics												
Respondents	489				489				489			
Observations	8802				8802				8802			
Log-Likelihood	−2771.239				−2529.085				−2502.040			
AIC	5558.479				5088.171				5036.079			
BIC	5615.14				5194.412				5149.403			

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
[a] Reference category = Conventional production; [b] Reference category = Tie stall; [c] Reference category = Transport to and killing in slaughterhouse; [d] Reference category = No greenhouse gas reductions; [e] Reference category = Origin from Switzerland but outside region (20 km); [#] GHG 1: GHG reductions with negative animal welfare impacts; [§] GHG 2: GHG reductions without animal welfare impacts.

for local origin is not significant). For GHG reductions that are accompanied by a detriment to animal welfare (GHG 1), there is a significantly negative WTP in the amount of −18 centimes, which shows a consumer aversion to GHG reductions that go along with negative animal welfare impacts.

In addition, we tested for a potential difference in preferences across both gender and the German- and French-speaking language regions (we have not gathered data for the Italian and Romanish regions). We did so by including, separately, interactions between gender and all attributes, and language region and all attributes. These interactions were included in specifications of CLM, RPLM with fixed price parameter, and RPLM with normally distributed price parameter (see Supplementary Material

Table 4
Conditional Logit and Random Parameter Logit Model specifications for the butter sample.

Butter sample	Model 1: Conditional Logit Model (fixed parameters)				Model 2: Random Parameter Logit Model (price fixed, others random)				Model 3: Random Parameter Logit Model (all random)			
	Coefficient	Std. err.	[95 % conf. interval]		Coefficient	Std. err.	[95 % conf. interval]		Coefficient	Std. err.	[95 % conf. interval]	
Mean Estimates												
No buy option	−0.284***	0.081	−0.443	−0.125	−1.141***	0.165	−1.464	−0.818	−1.050***	0.168	−1.375	−0.716
Organic[a]	0.208***	0.045	0.120	0.295	0.217***	0.0581	0.103	0.330	0.229***	0.066	0.100	0.358
Loose Housing[b]	0.827***	0.046	0.737	0.916	0.966***	0.066	0.837	1.095	1.082***	0.075	0.935	1.229
Farm Slaughter[c]	0.315***	0.045	0.227	0.402	0.357***	0.053	0.254	0.461	0.398***	0.059	0.283	0.513
GHG 1[d#]	−0.170**	0.062	−0.292	−0.048	−0.203**	0.073	−0.347	−0.060	−0.168*	0.080	−0.324	−0.012
GHG 2[d§]	0.285***	0.060	0.167	0.403	0.346***	0.072	0.205	0.486	0.410***	0.080	0.252	0.568
Local Origin[e]	0.079	0.045	−0.008	0.167	0.119*	0.054	0.012	0.225	0.130*	0.060	0.012	0.248
Price	−0.411***	0.037	−0.484	−0.338	−0.508***	0.044	−0.595	−0.421	−0.730***	0.069	−0.865	−0.596
Standard Deviation of Parameters												
No buy option					2.085***	0.146	1.798	2.371	2.119***	0.154	1.816	2.421
Organic[a]					0.606***	0.092	0.426	0.787	0.742***	0.097	0.551	0.932
Loose Housing[b]					0.741***	0.090	0.563	0.918	0.848***	0.102	0.649	1.047
Farm Slaughter[c]					0.246	0.130	−0.008	0.500	0.356**	0.114	0.133	0.579
GHG 1[d#]					−0.001	0.178	−0.350	0.348	0.040	0.259	−0.468	0.548
GHG 2[d§]					−0.399**	0.131	−0.656	−0.142	−0.336*	0.154	−0.638	−0.034
Local Origin[e]					0.0553	0.166	−0.269	0.380	0.147	0.160	−0.166	0.460
Price									0.780***	0.0751	0.633	0.927
Observations and Model Characteristics												
Respondents	497				497				497			
Observations	8946				8946				8946			
Log-Likelihood	−2793.858				−2573.214				−2531.254			
AIC	5603.716				5176.428				5094.508			
BIC	5660.508				5282.912				5208.091			

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.
[a]Reference category = Conventional production; [b] Reference category = Tie stall; [c] Reference category = Transport to and killing in slaughterhouse; [d] Reference category = No greenhouse gas reductions; [e] Reference category = Origin from Switzerland but outside region (20 km); [#] GHG 1: GHG reductions with negative animal welfare impacts; [§] GHG 2: GHG reductions without animal welfare impacts.

Table 5
Marginal willingness to pay in CHF and 95 % confidence intervals for one liter of drinking milk.

Milk sample	**Model 1: Conditional Logit Model (fixed parameters)**			**Model 2: Random Parameter Logit Model (price fixed, others random)**			**Model 3: Random Parameter Logit Model (all random)**		
	WTP	LL	UL	WTP	LL	UL	WTP	LL	UL
No buy option	−0.465	−0.679	−0.267	−1.221	−1.663	−0.845	−0.784	−1.103	−0.523
Organic[a]	0.299	0.185	0.424	0.279	0.152	0.416	0.217	0.115	0.329
Loose Housing[b]	0.950	0.787	1.164	0.929	0.768	1.127	0.724	0.595	0.887
Farm Slaughter[c]	0.313	0.206	0.451	0.308	0.205	0.439	0.255	0.172	0.361
GHG 1[d#]	−0.236	−0.406	−0.075	−0.264	−0.426	−0.103	−0.181	−0.306	−0.058
GHG 2[d§]	0.243	0.110	0.406	0.249	0.121	0.400	0.203	0.099	0.328
Local Origin[e]	0.075	−0.034	0.183	0.086	−0.019	0.199	0.085	0.002	0.173

[a] Reference category = Conventional production; [b] Reference category = Tie stall; [c] Reference category = Transport to and killing in slaughterhouse; [d] Reference category = No greenhouse gas reductions; [e] Reference category = Origin from Switzerland but outside region (20 km).
[#] GHG 1: GHG reductions with negative animal welfare impacts; [§] GHG 2: GHG reductions without animal welfare impacts.

Table 6
Marginal willingness to pay in CHF and 95 % confidence intervals for one portion/block of butter (∼ 225 g).

Butter sample	**Model 1: Conditional Logit Model (fixed parameters)**			**Model 2: Random Parameter Logit Model (price fixed, others random)**			**Model 3: Random Parameter Logit Model (all random)**		
Attributes	WTP	LL	UL	WTP	LL	UL	WTP	LL	UL
No buy option	−0.691	−1.109	−0.304	−2.247	−3.066	−1.550	−1.431	−2.025	−0.934
Organic[a]	0.505	0.283	0.762	0.426	0.190	0.679	0.314	0.127	0.512
Loose Housing[b]	2.011	1.679	2.448	1.902	1.588	2.290	1.480	1.233	1.793
Farm Slaughter[c]	0.765	0.543	1.049	0.704	0.500	0.968	0.544	0.384	0.749
GHG 1[d#]	−0.414	−0.748	−0.090	−0.400	−0.702	−0.097	−0.230	−0.458	0.000
GHG 2[d§]	0.694	0.414	1.021	0.681	0.420	0.990	0.561	0.351	0.810
Local Origin[e]	0.193	−0.024	0.413	0.234	0.030	0.453	0.178	0.021	0.346

[a] Reference category = Conventional production; [b] Reference category = Tie stall; [c] Reference category = Transport to and killing in slaughterhouse; [d] Reference category = No greenhouse gas reductions; [e] Reference category = Origin from Switzerland but outside region (20 km).
[#] GHG 1: GHG [reductions] with negative animal welfare impacts; [§] GHG 2: GHG reductions without animal welfare impacts.

4, Tables S14-S19).[16] Whereas for the language region, results are inconsistent across specifications – i.e. differences across language regions may or may not be significant and they may or may not yield consistently positive or negative signs –, some evidence arises that women have stronger preferences for better housing conditions compared to men (see Supplementary Material 4, Tables S14-S16). This observation holds across all three specifications (CLM, RPLMs with fixed and random price coefficient). However, the statistical fit, as measured by the BIC, is worse for the specifications with interactive variables. Therefore, we kept the RPLM specification with no interactions as the preferred specification.

3.2. Preferences and willingness to pay for the butter sample

As reported in Table 4, which refers to parameter estimates of the butter sample, a similar pattern as for the milk sample is observed. For the CLM, all coefficients are significant except for product origin. For the RPLM models, the coefficient for product origin is also significant at 5% level. The signs and thus consumer preferences for the respective attributes are the same as for the milk sample in each case. Thus, consumers indicate a preference for i) organic compared to conventional butter production; ii) keeping animals in a spacious loose housing system compared to tethering; iii) killing animals on farms compared to transporting and killing them in the slaughterhouse; and iv) reducing GHG emissions in production *without* compromising animal welfare. Furthermore, consumers dislike production-side GHG reduction measures that compromise animal welfare.

The (marginal) WTP for the respective attributes is shown in Table 6. Again, apart from the "No buy"-option, the values differ slightly but tend to be similar between the three models. The results show that the WTP for the two animal welfare improvements – farm killing and loose housing – is higher in absolute terms for the product butter than for the product milk, with both differences being significant even after Bonferroni correction. The calculated marginal WTP for farm killing compared to slaughterhouse killing is 54 centimes for 1 block/package (approx. 225g) of butter; for keeping the animals in a large loose house rather than in tethering, the WTP is 1.48 CHF. WTP for greenhouse gas reductions *without* negative animal welfare impacts is 56 centimes. It is striking that for butter, the WTP for organic production (31 centimes) is considerably lower than for farm killing and GHG reductions without animal welfare impairment, whereas this is not the case for milk (see above). For GHG reductions with impairment of animal welfare, there is again a negative WTP (−23 centimes); however, just not significant for model 3 ($p = 0.05$), but significant for models 1 and 2). For local production, a WTP of 18 centimes was calculated for butter (although this is again not significant in model 1).

Moreover, since butter is the more expensive of the two products – consumers qed paying a median of CHF 1.80 for a liter of milk and CHF 3.51 for a packet of butter – and the higher absolute WTP for animal welfare improvements could be related to the higher starting price for butter, WTP was also calculated based on the relative price premiums mentioned in the DCE (0% to 40% price increase compared to the current purchase price), i.e. not on the basis of the price in absolute terms as for the above values. The underlying models are presented in Supplementary Material 2, Tables S2 and S3, the resulting WTP figures ibid., Tables S4 and S5. Using the figures for the RPLM model with normally distributed price parameter, which again exhibits the best model fit, it can be seen that the percentage price premium on the current product price that consumers are willing to pay for animal welfare improvements does not differ significantly between milk and butter and is about the same.[17] The percentage price premium that consumers are willing to pay for farm slaughter is 14% for milk and 15% for butter; that for keeping animals in a large loose housing system instead of tethered housing is 40% for milk and 41% for butter.

In addition, as for the milk sample above, we used interactive variables to test for potential differences in preferences across both gender and language regions (see Supplementary Material 4, Tables S20-S25). The corresponding models yield evidence that women and people living in the German-speaking part of Switzerland have stronger preferences for attributes aiming to increase the welfare of animals (see Supplementary Material 4, Tables S20–S22). Whereas for the language region, this result is not consistent across the three model specifications, for gender it is. Our results show positive and significant interaction effects for women for *both* better slaughter and better housing conditions of the animals across all three specifications (CLM, RPLMs with fixed and random price coefficient). However, the statistical fit, as measured by the BIC, is worse for the specifications with interactive variables. Therefore, we kept the RPLM specification with no interactions as the preferred specification.

4. Discussion

This study documents a relatively high stated preference for animal welfare among Swiss consumers of milk and butter. This finding is consistent with recent international studies (e.g., Ammann et al., 2024; Howard & Allen, 2006; Howard & Allen, 2010; Kaminski et al., 2023; Kitano et al., 2022; Markova-Nenova and Wätzold, 2017; Naspetti et al., 2021; Tavárez & Álamo, 2021) as well as with a recent study focused on Switzerland (Ammann et al., 2023). Our study complements findings by recent studies that document increasing consumer awareness – via information or emotive messages about negative impacts on animal welfare – can reduce consumers' purchase intentions by evoking negative feelings such as shame or guilt (Kranzbühler & Schifferstein, 2023; Ioannidou et al., 2023). Our findings suggest that dairy consumers are willing to voluntarily face higher prices if informed about animal welfare benefits associated with production practices motivating the higher prices.

Consumers in our study report a comparatively high importance to housing conditions. Their WTP for generously dimensioned loose housing, instead of tethering stalls, is 1.48 centimes per portion/block of butter and 72 centimes per liter milk. Considering that consumption of milk amounts to about 3.9kg per month and person on average in Switzerland (BLW, 2022), and one liter of milk weighs approximately 1.03kg, Swiss consumers' average monthly purchases would increase by 2.73 CHF per person for a corresponding housing improvement. At household level, these numbers translate into a 1.01% increase in average food budget and 0.13% increase in average consumption expenditure of Swiss households.[18] Considering a usual weight of 250g for one block of butter and the average monthly consumption of about 433g per person in Switzerland (BLW, 2022), the monthly WTP for housing improvement via the butter market would amount to 2.56 CHF per person. At household level, this number translates into 0.96 % increase in average food budget and 0.12% increase in average

[16] We thank the anonymous reviewer for suggesting the exploration of interaction effects for gender and language regions.

[17] The same applies to the other two models (see tables S4 and S5 in Supplementary Material 2). The values for the WTP in relative terms are given without Bonferroni correction. A Bonferroni correction was not applied in this case because the WTP values for the animal welfare improvements are already not significantly different without correction.

[18] These and subsequent calculations with respect to household expenditures are based on the average household size of 2.19 persons per household in Switzerland (BfS, 2022c) and household consumption data from BfS (2022a).

consumption expenditure. Thus, while marginal WTP in absolute terms is higher for butter compared to milk, monthly WTP for generously dimensioned loose housing is similar across milk and butter markets. This similarity in WTP across milk and butter samples provides internal validity to this paper's findings because housing conditions are the same regardless the market through which consumers compensate for improvement in animal welfare and, therefore, WTP for housing conditions should be similar across samples.

For both milk and butter, the WTP for the improvement in animal housing is higher than for all other production-related attributes in our DCE, including the second animal welfare related attribute of slaughter conditions. This result is consistent with findings reported by Carlsson et al. (2005), who estimated a high WTP and importance for loose housing compared to tethering in Sweden, significantly higher than for not separating cow and calf shortly after birth. Compared to improvements in the slaughter of animals, housing conditions affect a relatively large share of the animals' lifetime. The duration of the conditions which the animals face can be seen as an important consideration when evaluating the relevance of their impact on the animals' welfare or life quality, with more frequent and persistent impacts ceteris paribus having a greater weight compared to less frequent or persistent ones (Bracke et al., 2002; Hampton et al., 2021; Scherer et al., 2018). The same reasoning could underly consumers' preferences as observed here, indicating a higher WTP for improved housing compared to improved slaughter conditions. This could, however, be somewhat counteracted by stronger psychological responses of participants to slaughter compared to housing conditions.[19] We did not investigate this any further in this study and encourage future research in this direction.

The high absolute WTP may be due to two reasons: on the one hand, a tendency to overestimate WTP in hypothetical decision experiments such as DCEs is known in the literature and WTP should therefore be interpreted in terms of an upper limit (Wolf & Tonsor, 2017); on the other hand, the attribute of loose housing was varied between the two options of tethering and keeping the animals in a *large* loose housing stall, described as generously dimensioned. Since only slightly less than half of the Swiss dairy farms practice tethered housing, the reference level for loose housing does not represent the market standard in Switzerland. In addition, the spacious loose housing system represents an additional improvement to the general loose housing system. Thus, the high WTP must not be interpreted as an additional WTP for a free stall system compared to the market standard, but as a WTP for an advanced free stall system compared to a tethered system. The high WTP could therefore also be due to a strong consumer aversion to tethered housing. In any case, the findings of this study indicate that consumers have a clear preference for loose housing systems and attribute high importance to the type of housing.

For investments in switching from tether-only to loose housing, Bergschmidt et al. (2018) showed a varied cost range between 0,26 and 13,42 ct/kg milk for Germany, depending on whether only an extension, reconstruction or new barn construction is required. As we found the willingness of consumers to pay for a conversion from tether-only to loose housing to be much higher than the upper cost limit, and tethering is a key weakness of the Swiss dairy industry from an animal welfare perspective compared to other countries (e.g., Boessinger & Hoffet, 2019), the development towards loose housing, which has already taken place for several years both within and outside of Switzerland (Pfefferli et al., 1994; SRG, 2022; SRF, 2022), should be further promoted by farmers, agricultural associations, and policy makers – both from an animal welfare perspective and with regard to the public's acceptance of dairy farming and consumers' WTP. Thereby, special care should be taken to ensure sufficient size of the free stalls in new buildings, as our findings as well as the animal welfare classification from the expert interviews prior to this study (cf. introduction and Section 2.1.1) indicate. This is particularly relevant since these are long-term investments for which consideration of future consumer expectations may be essential (Bolton & Von Keyserlingk, 2021). Concrete and effective tools for improvements in housing already exist in Switzerland: for example, BTS[20] payments can be linked to a sufficient size of free stalls, determined by independent experts, with more room for movement of the animals. Finally, our findings indicate that transparent product labeling regarding the housing type is worthwhile, e.g., in retail trade or organic stores, especially in light of recent research showing that European consumers consider animal welfare labels as helpful and important – and more important than environmental product labelling (Ammann et al., 2024).

We found a positive WTP of about 26 centimes per liter of milk and 54 centimes per portion/block of butter for farm killing. Based on the same calculations and statistics as above, this would amount to average additional monthly expenses of 0.98 CHF per person, or 0.37% increase in average food budget and 0.05% increase in average consumption expenditure of Swiss households for milk. For butter, the calculation amounts to an additional monthly expenses of 0.94 CHF per person, with a 0.35% increase in average food budget and 0.04% increase in average consumption expenditures. As for housing improvement above, the increase in total consumption expenditures would therefore be similar for milk and butter. In a survey by Waldrop and Roosen (2021) in eight European countries, participants also reported a high importance to slaughter conditions. Furthermore, a positive WTP for slaughter in mobile abattoirs compared to transport and killing in the slaughterhouse has been found in a Swedish study by Carlsson et al. (2007). Increased promotion of farm and pasture slaughter would represent a major improvement from an animal welfare perspective and could become an important differentiator, especially in the organic sector. Ways must be found to make this practice visible to consumers on products or during sales. Direct marketing in farm stores allows farmers to achieve this; but retailers would also have leverage here and could promote farm and pasture killing, for example, via animal welfare programs and pioneer projects.

Our findings show a positive and significant WTP for GHG reductions without animal welfare impacts, exceeding the WTP for organic and local production. Yet consumers are opposed to GHG reduction measures with negative impacts on animal welfare, which is reflected in a negative WTP for the DCE attribute reflecting GHG reduction measures associated with compromised animal welfare. To our knowledge, this is the first DCE with dairy products that investigated this. Indeed, our findings are consistent with recent surveys on the acceptance of policy measures to reduce meat consumption, finding a considerably higher public support if these policies were motivated by animal welfare rather than climate or environmental reasons (Bhattacharya et al., 2023; Perino & Schwickert, 2023). Moreover, they are consistent with a recent international survey in five European countries, including Switzerland, showing that consumers across countries place higher importance on animal welfare in meat and dairy consumption compared to organic production, the carbon footprint or other environmental product characteristics (Ammann et al., 2024). Animal welfare concerns seem to take precedence over climate and environmental concerns in the publics' perception when it comes to food production. This is a potentially important insight with far-reaching implications for farmers and farmer associations as well politicians aiming for sustainability improvements in the food system and should be further investigated, as a recent study with institutional and industry stakeholders in Switzerland also found a higher acceptance for intervening meat reduction measures if these were

[19] We thank the anonymous reviewer for pointing out this difference in duration and psychological effect, which we picked up on here.

[20] BTS stands for particularly animal-friendly housing systems ("Besonders tierfreundliche Stallhaltungssysteme") and is a state program in Switzerland that supports farmers for improvements in housing conditions for their animals (BLW, 2023b).

targeted to animal welfare improvements compared to measures directly aimed at reducing meat production, e.g., via VAT increases (Richter et al., 2023).

For organic production of drinking milk, we found a WTP of 22 centimes per liter, which corresponds almost exactly to the current average premium for organically produced milk in Switzerland (BLW, 2023a), and thus speaks for the validity of the results of our milk DCE. This WTP is, however, lower than consumers' WTP for the two animal welfare improvements. This result is in contrast with the meta-analysis conducted by Li and Kallas (2021), who found a lower WTP for animal welfare than for organic production (although higher than for both environmentally friendly and local production attributes). However, their analysis was not primarily focused on dairy products but on different kinds of food products. On the other hand, the already mentioned recent international survey by Ammann et al. (2024) is consistent with our finding, indicating that consumers attribute a higher significance to animal welfare compared to organic production in meat and dairy consumption. For organic farming, animal welfare is an important competitive argument. In several international surveys, organic consumers assign a high importance to animal welfare, also in comparison to other sustainability-relevant aspects (Akaichi et al., 2019; Harper & Makatouni, 2002; Zander & Hamm, 2010). This is also apparent in recent surveys in Switzerland that report consumers rating animal welfare-relevant aspects as central and, among sustainability-related aspects, the most important motives for buying organic products (Korner et al., 2022; Stolz, 2020). We highlight, however, that there is an indication that consumers focus selectively on individual criteria when choosing certain products rather than on the complex and for many consumers mostly unknown organic production system. This phenomenon has also been documented among organic consumers in Germany (Stolz et al., 2009; Baranek, 2007).

Akaichi et al. (2019) showed that animal welfare arguments can increase WTP for organic products and argue that greater emphasis on animal welfare friendliness of organic products could contribute to increases in demand. Consistent with the results of the present study, they found a higher WTP for an animal welfare labeling of ham than for an organic labeling and a strong effect of information on the animal welfare benefits of organic production on consumers' WTP for organic products. Similarly, Scozzafava et al. (2020) found a higher WTP for organic milk when providing consumers with animal welfare information of organic products, whereas information on quality and production costs of organic products did not lead to a higher WTP. Organic milk production has animal welfare advantages in several areas compared to conventional production. In Switzerland, regular outdoor exercise and grazing is mandatory for cows in organic production and a high proportion of roughage is required in the animals' diet (Organic Ordinance, 2023). Depending on the organic label, there are also more extensive animal welfare benefits. By expanding and highlighting these animal welfare benefits of organic production, organic organizations and farmers can generate important competitive advantages.

Finally, findings from our interaction models indicate stronger animal welfare preferences among women than among men, especially regarding housing improvements, but also for improving slaughter conditions in the butter product sample. This corresponds to the broader literature on public animal welfare concern which shows that women generally tend to attribute more importance to animal welfare compared to men (e.g., reviewed by Cornish et al., 2016). Results of our interaction models also indicate a weak tendency for stronger animal welfare preferences among the German compared to the French speaking population of Switzerland; but this finding is inconsistent across different model specifications, dairy products and attributes.

Limitations

This study is accompanied by some limitations. It is conceivable that answers to the DCE were influenced by the mainly animal welfare-related knowledge questions at the beginning of the questionnaire, which included questions on tethering and organic production, but not on farm killing and greenhouse gas reductions. The questions on tethering and organic production were included because of the high practical interest of these questions and the corresponding knowledge of consumers. However, since these were pure knowledge questions and there were several other questions between the knowledge questions and the DCE, a potential influence is likely to have been rather small. Since no clear reference dairy product exists in the Swiss market for most attributes in our DCE (apart from the distinction between organic and conventional production) due to the lack of product information on the differences in the attribute characteristics, we did not include a status quo option. Effectively, the respondent choosing the "I prefer not to buy the products" option cannot be thought as choosing his/her current product, but instead as rejecting the options presented in the choice card, which we believe is consistent with exploring whether consumers favor or don't favor the introduction in the market of the goods under consideration in the choice card. To relate the changes in prices in our DCE more closely to actual market prices, and since prices for dairy products differ significantly between purchase channels in Switzerland, we used relative price increases with respect to the varying product characteristics, considering stated current payments of respondents for their respective dairy products. It is possible that respondents did not estimate their actual costs fully accurately or did not consider the absolute price increases for the respective products fully accurately, but instead over- or underestimated the absolute price increases. Furthermore, as with hypothetical choice experiments and online surveys in general, it is possible – and to some degree also probable – that the answers obtained here differ from actual consumer behavior in real-market situations, meaning that, for example, although we aimed to reduce this hypothetical bias (see Section 2.1.1), consumers could have overestimated their "real" WTP (Wolf & Tonsor, 2017; see also our discussion of the results in Section 3 above). Future research on group-specific differences in preference patterns and WTP will add knowledge on consumer segments and different target groups. However, a consumer segmentation was not the scope of this research. Lastly, we combine GHG emission reductions and animal welfare impairments in a single attribute. This combination could be conceptualized as a labelled design instead of the unlabelled design used in this study. As the presentation of the DCE to the respondents did not follow a labelled strategy, we cannot know whether they interpreted our DCE as labelled or not. This opens up the methodological research question of whether the stated WTP across the labelled presentation using an alternative specific constant is different from the unlabelled presentation we used in this study. We explicitly encourage future research to investigate this point.

5. Conclusions

Demands for more sustainable food production pose major challenges for the dairy industry. In addition to the social-ecological impacts of milk production, the use of animals for agricultural production is under debate. Our findings indicate a high importance of animal welfare for Swiss consumers. We found a positive and comparatively high WTP for the two animal welfare improvements of loose housing and farm killing, with the former going well beyond the WTP for other sustainability improvements such as greenhouse gas reductions or local supply of dairy products. Furthermore, consumers opposed measures that would reduce greenhouse gas emissions while worsening animal well-being in dairy farming. These findings are important for agricultural stakeholders and politicians with respect to the long-term development of their production, the direction of their consumer communication and the design of policies for a sustainable transformation of the food system. They show that animal welfare has priority for consumers and that improving and ensuring high animal welfare standards should be a prerequisite for other sustainability improvements in dairy production.

Ethical statement

Our survey data collection was performed in accordance with all relevant institutional and national ethical guidelines in Switzerland. The survey invitation and the survey welcome page explained to survey takers (Swiss consumers) that the study was to measure their "attitudes, knowledge and preferences about Swiss dairy production." They were informed that all data will be de-identified, only reported in the aggregate, and would be used "exclusively for scientific purposes and subsequent publications of the research results." Invitees were informed that their participation was voluntary, and they could leave the survey at any time without any disadvantages. They were financially compensated for their participation according to the panel service (Bilendi) provider's customer agreement. The project team did not obtain any personal data that could be used to identify the individual participants (in particular, their identity, contact identity, contact details and other data that led to their selection by the panel service provider).

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used DeepL in order to perform translations, e.g., for translating the English questionnaire version for Supplementary Material 1. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

CRediT authorship contribution statement

Sebastian Richter: Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Hanna Stolz:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization. **Adan L. Martinez-Cruz:** Writing – review & editing, Supervision, Methodology, Formal analysis, Conceptualization. **Aya Kachi:** Writing – review & editing, Supervision, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Aya Kachi reports financial support was provided by Sur-la-Croix Foundation. Aya Kachi reports financial support was provided by KAGfreiland. Sebastian Richter reports financial support was provided by Sur-la-Croix Foundation. Sebastian Richter reports financial support was provided by KAGfreiland. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.foodqual.2024.105350.

Data availability

Data will be made available on request.

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