Org. Agr. (2025) 15:307–326
https://doi.org/10.1007/s13165-025-00499-4

RESEARCH

Market potential for organic dairy and meat products from "calf-friendly" dairy farms across different consumer segments

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Received: 7 September 2024 / Accepted: 7 March 2025 / Published online: 26 March 2025

Abstract As public criticism of the management of surplus dairy calves increases, new approaches are required to improve calf welfare to maintain the dairy industry's license to produce. Little is known about consumers' willingness to buy (WTB) organic dairy and meat products from farms that aim to improve the welfare of surplus dairy calves. This study aims to address this research gap by identifying potential target groups for assessing the market potential of these products in south-west Germany. For this purpose, an online survey was conducted among 922 participants in this region. Participants were presented with one of three scenarios describing different rearing systems for dairy calves that hold the potential to provide enhanced calf welfare in comparison to current dairy farming practices: Cow-calf contact, the use of dual-purpose breeds and on-farm slaughter. Factor and cluster analyses were performed to identify potential target groups for organic dairy and meat products from these "calf-friendly" rearing systems. The four clusters Conscious organic shoppers, Moderate sustainability advocates, The indifferent consumers and the Interested organic refusers were identified. The findings indicate that organic consumers who care about calf welfare and prioritize product quality and sustainability when buying food are a promising target group for products from "calf-friendly" organic dairy farms. Consumers' WTB seems to depend more on their general attitudes and financial means than on the presented scenarios. By identifying a potential target group for these products, this study fills a research gap and may contribute to more effective and targeted marketing.

Keywords Surplus dairy calves · Animal welfare · Willingness to buy · Organic · Cluster analysis

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Introduction

Historically, dairy farming has received less public criticism compared to other livestock sectors (Christoph-Schulz et al. 2019). However, in recent years, some dairy farming practices involving dairy calves (e.g. early cow-calf separation) have come under increasing public scrutiny (Busch et al. 2017; Ventura et al. 2013). The management of "surplus dairy calves" constitutes a particularly complex challenge

(see review by Bolton and von Keyserlingk 2021) and is associated with various animal welfare issues (see review by Creutzinger et al. 2021). Animal welfare, as defined by Fraser (2009), encompasses the physical health and functioning of animals ("basic health and biological functioning"), the opportunity to exhibit natural behaviors ("natural living"), the reduction of unpleasant feelings such as pain and fear, and the allowance of normal pleasures ("affective states"). These aspects of animal welfare are challenged at each stage of the surplus calf production system (see review by Creutzinger et al. 2021). In organic farming, animal welfare is predominantly understood in terms of "natural living" (Lund 2006). Although regulatory requirements ensure the implementation of certain elements of naturalness in organic calf-rearing systems, the life of organic dairy calves may still differ significantly from what is considered natural (Vetouli et al. 2012). For instance, the separation of cow and calf shortly after birth, a common practice in both conventional and organic dairy farming (see review by Kälber and Barth 2014), is regarded as unnatural and detrimental to animals' welfare by the majority of the public (Ventura et al 2013; Busch et al. 2017; Hötzel et al. 2017). While many of the female calves born on dairy farms remain on the farm as replacement heifers, all male and some female calves are considered surplus to the farm's replacement requirements (Bolton et al. 2024). A study conducted in Baden-Württemberg (south-west Germany) by Reiber et al. (2020) found that in the two dairy breeds Black & White and German Red Holstein, the proportion of female organic dairy calves accounted for 13% of the total number of marketed organic calves for each of these breeds. Breeds commonly used in modern dairy farming are highly specialized for milk production but less suitable for meat production (Placzek et al. 2021). These breeds have been found to have a lower average daily weight gain and a less desirable carcass conformation compared to crossbreeds (Huuskonen et al. 2013; Rezagholivand et al. 2021) and pure beef breeds (Pfuhl et al. 2007), making them less suitable for profitable beef production (see review by Bolton and von Keyserlingk 2021). The lower economic value of male surplus calves compared to the replacement heifer calves potentially results in inadequate care for these animals (Renaud et al. 2017), which may lead to higher rates of morbidity and mortality (Hyde et al. 2020). The management of surplus dairy calves differs depending on the country and the operational environment (Bolton et al. 2024). While most surplus calves are slaughtered for veal or beef, in some countries it is not uncommon to euthanize surplus calves shortly after they are born (see review by Creutzinger et al. 2021). However, the killing of animals without reasonable cause is illegal in Germany (BMJV 1972). Hence, surplus dairy calves born in Germany are usually sold to fattening farms at a young age and subsequently slaughtered for the production of beef or veal (Placzek et al. 2021). According to Reiber et al. (2020), most surplus calves from organic and conventional dairy farms in Baden-Wuerttemberg (south-west Germany) are sold to conventional fattening farms in northern Germany or to other European countries when they are about two to five weeks old. The long-distance transportation of calves is associated with numerous welfare concerns, due to the repeated processes of loading and unloading, the deprivation of feed and water, the extended periods spent in moving vehicles and the stress of encountering unfamiliar calves (EFSA Panel on Animal Health and Welfare 2022). The transportation of young calves (14 days old) has been demonstrated to be a significant risk factor for mortality at the veal farms (Marcato et al. 2022). Additionally, the rearing of dairy calves in veal farms for the production of white veal is also problematic in terms of animal welfare (for a review, see Haskell 2020). Selling dairy calves to conventional fattening farms is particularly controversial in organic farming, as it does not comply with the principles of organic farming (Nielsen and Thamsborg 2002). However, the general public in Germany is still predominantly unaware of the complex issue of surplus dairy calves but are concerned about calves' welfare when informed about the fate of these animals (Herrler et al. 2023; Schulze et al. 2023). In order to maintain their license to produce, the dairy and related industries are advised to proactively develop alternative strategies for managing surplus dairy calves, with consideration given to the attitudes and values of consumers and other stakeholders (see review by Creutzinger et al. 2021).

Several strategies have already been identified to improve rearing conditions for surplus calves, addressing various critical aspects of calf management. Some approaches tackle the core issue, the low value of surplus dairy calves, by improving meat characteristics and thus the market price of these

animals, which can be achieved, for example, by using dual-purpose breeds (Webb et al. 2023). Calves from these breeds are heavier than those from specialized dairy breeds, resulting in a higher economic value (Zanon et al. 2023). The findings of Reiber et al. (2020) demonstrate that dual-purpose breeds are already being used in the German dairy industry: Among the marketed dairy calves analyzed in the study, 51.9% belonged to the dual-purpose breed 'Fleckvieh'. Other strategies relate to rearing systems for surplus calves on the dairy farm, e.g. dam rearing (Webb et al. 2023). Dam-calf contact rearing is a specific type of cow-calf contact (CCC) rearing. CCC rearing includes all systems that allow physical contact between a calf and its dam or a foster cow (Sirovnik et al. 2020). Prolonged CCC may have a beneficial impact on the health and growth of calves during the milk-feeding period (Eriksson et al. 2022; Meagher et al. 2019). Higher body weights of calves upon arrival at the veal farm are linked to higher average daily weight gains (Goetz et al. 2021) and a lower risk of mortality (Goetz et al. 2021; Renaud et al. 2018). A study by Webb et al. (2022) indicated that dam-reared veal calves were significantly heavier from week 3 onwards on the dairy farm and at their arrival at the veal farm than calves that were separated early from their dam. However, these weight differences could no longer be determined at the time of slaughter. An abrupt separation of calves from their dams, as well as an heightened fear of humans, may have negative consequences for the welfare of dam-reared calves in the long term. In order to reduce negative experiences related to the cow-calf separation, Wenker et al. (2022) recommend a gradual reduction of physical contact prior to weaning in full CCC systems, which is typically associated with a delayed weaning age. Calves that remain on the dairy farm for a longer period and are transported at 28 days of age rather than 14 days have a more advanced development of their adaptive immune system and are consequently more robust (Marcato et al. 2022). Hence, Creutzinger et al. (2021) suggest in their review to keep the animals on the dairy farm until they are old enough to be transported is one of the best ways to avoid the negative consequences of long-distance transport. Alternatively, calves may be reared on the farm of origin from birth to slaughter (see review by Creutzinger et al. 2021). Animal transport and the associated AW issues can be entirely eliminated by alternative slaughter methods, such as mobile abattoirs, as the slaughter takes place on the farm (Bayer et al. 2023; Eriksen et al. 2013).

Previous studies have explored the attitudes of citizens and consumers towards alternatives for dealing with surplus dairy calves. According to Schulze et al. (2023), alternatives that are perceived as more natural by consumers like e.g. extended on-farm fattening, use of dual-purpose breeds, extended inter-calving periods are rated positively. The authors hypothesized that the strategy "extended on-farm fattening" was considered best because participants may have assumed it would keep calves with their dams for a longer period. Whilst the majority of citizens support dam rearing as this is regarded as the most natural approach (Sirovica et al. 2022), foster cow systems may be perceived as more economically and practically feasible by farmers (Bertelsen and Vaarst 2023).

Enhanced AW standards commonly necessitate substantial financial investments, increasing the probability of higher prices for the resulting products (Yang 2023). As AW standards are demand-oriented, it is crucial to assess the market potential (Clark et al. 2017) e.g. by determining consumer willingness to buy (WTB) AW products, since this is an important driver for livestock transformation towards improved AW (Yang 2023). Consumers' WTB is significantly influenced by their moral attitudes towards animal products (Beldad and Hegner 2020; Yang 2023; Yeh and Hartmann 2021). According to a review by Boaitey and Minegishi (2020), besides consumers' attitudes towards animals, socio-demographic characteristics such as gender, age, education and income are also significantly associated with consumer preference for higher farm AW standards. Furthermore, consumers' demand for farm AW has been found to be related to preferences for other food attributes, including food safety, organic and environmental concerns. The findings of Wojciechowska-Solis and Barska (2021) demonstrate that consumers who care about environmental sustainability and AW are more willing to purchase organic food.

Concerning the management of dairy calves, the results of a study conducted by Boaitey et al. (2022) indicate that the majority of consumers prefer a prolonged contact between dam and calf and are willing to pay a premium for milk from those CCC systems. Sirovica et al. (2022) also found that consumers are willing to pay the same or more for milk from

production systems that provide longer dam-calf contact compared to the amount they typically spent on their milk. Furthermore, the findings of previous studies indicate that consumers are willing to pay a premium for beef from dual-purpose breeds (Schulze et al. 2021) and from on-farm slaughter (Carlsson et al. 2007). However, pricing has a significant impact on the willingness to pay (WTP) for this kind of meat, emphasizing the necessity for targeted marketing strategies aimed at less price-sensitive consumers (Lauterbach et al. 2023), e.g. those who buy organic meat (Bayer et al. 2023). While previous studies have investigated public attitudes towards alternative strategies for managing surplus dairy calves and consumers' WTP for products from such rearing systems, to the best of our knowledge, no research has explored the general interest in purchasing dairy and meat products from organic dairy farms that implement strategies aimed to improve the welfare of surplus dairy calves. In the present study, these organic dairy farms are referred to as "calf-friendly" rearing systems, as they may improve the welfare of surplus calves in different ways. Accordingly, the aim of the present study is to examine consumers' WTB organic dairy and meat products from different "calf-friendly" rearing systems and to identify potential target groups through consumer segmentation in order to assess the market potential of these products. As consumers of meat and dairy products differ in their perception of the importance of food quality (e.g. sensory appeal and healthiness), food sustainability (including AW) and price (Yue et al. 2024), this study also examines consumers' perceptions of different aspects of dairy calf management and food sustainability. The findings of this study may contribute to the development of target-group oriented and efficient marketing strategies, thereby supporting the establishment of a more sustainable value chain for organic surplus dairy calves.

Materials and methods

Procedure

For the present study, consumers from south-west Germany were surveyed in March 2021 using a self-designed quantitative online questionnaire.[1] Participants were recruited by a market research company.[2] To obtain a representative sample distribution for the states of Baden-Wuerttemberg, Rhineland-Palatinate, Hesse and Saarland, participants were recruited by quotas on gender, age and place of residence (federal states). The survey was conducted anonymously. After purging outliers, 922 cases were left for further analysis.

Questionnaire design

The survey was conducted using the software Unipark (Tivian XI GmbH).[3] First, participants were asked which federal state they lived in, which gender they assigned themselves to, and what age they were. Individuals under the age of 18 and those who did not live in any of the federal states listed above were excluded from the survey. The participants were then queried about their dietary and grocery shopping habits. They were requested to indicate whether they follow an omnivorous, pescetarian, flexitarian, vegetarian or vegan diet, or whether they abstain from milk and dairy products but consume meat. Non-meat eaters were asked on a 6-point scale whether they could imagine eating meat again in the future (from 1 = "no, absolutely not" to 6 = "yes, absolutely"). Those who stated that they do not consume milk or dairy products were asked to indicate whether they might consider consuming these again in the future. Participants were also asked how often they were responsible for purchasing groceries for their household using a 5-point scale (1 = "never" to 5 = "always"). Moreover, they were queried how important they consider various product and production-related aspects (e.g. taste, healthiness, local food production) when buying food by means of a 6-point rating scale, ranging from 1 = "very unimportant" to 6 = "very

[1] Parts of the data collected in this survey were previously used for addressing a different research question. The results of this analysis were published by Herrler et al. (2023). The socio-demographic variables and the variable 'attitude towards various AW aspects in dairy calf management' have been reused in this data set.
[2] Market research company "Bilendi": https://www.bilendi.de/
[3] Tivian XI GmbH: https://www.unipark.com/en/

important". Furthermore, participants were asked to indicate how important they consider having a clear conscience when buying food, trying new foods and buying food that is also bought by their friends. To avoid order bias, items used were randomized. In the next section, participants' attitudes toward various AW aspects in dairy calf management (e.g. CCC, grazing, transportation of calves) were measured by 12 items, using the same 6-point scale that was applied to measure the importance placed on aspects related to food purchases. Again, these items were randomized to avoid order bias. Next, participants were informed about the issue of surplus dairy calves by means of a quiz which consisted of three single-choice questions, each with four possible answers. The quiz required participants to estimate the number of calves dairy cows give birth to in a year, how many organic surplus dairy calves from Baden-Wuerttemberg are approximately sold to conventional fattening farms, as well as the number of these calves that are shipped abroad. Once a question was answered, participants received a text with the solution. These answers served as a step-by-step educational tool that explained the causes of surplus dairy calves, the lack of profitability of raising these animals, and common practices in dealing with organic surplus calves in Germany. After being informed about the issue of surplus dairy calves through the quiz, participants were given one of three possible scenarios including strategies that farmers can implement to improve the fate of surplus dairy calves: CCC during the milk feeding period, the use of dual-purpose breeds and a longer life span or stress-free on-farm slaughter. The scenarios describe the handling of organic dairy calves from birth to slaughter, in order to ensure the comparability of subsequent responses. Participants were randomly assigned to one of the three scenario groups to eliminate accidental bias (e.g. selection bias).

Scenario 1: CCC system

After birth, dairy calves are allowed to stay with their dam or a foster cow and drink from the udder for at least three months. After being gradually weaned from their dam/foster cow, the calves are raised apart from their dam/foster cow on the same farm they were born on. At the age of six to eight months they get transported to a slaughterhouse within a maximum radius of 200 km and get slaughtered.

Scenario 2: Dual-purpose breeds

Instead of using specialized dairy breeds for milk production, dual-purpose breeds are utilized. Cows of these breeds produce less milk than cows of specialized dairy breeds, but the calves produce more meat, which makes rearing more profitable. The calves are separated from their dam after birth, are fed cow's milk from a bucket for three months, and then sold to a nearby organic fattening farm. On this farm the calves are kept according to the standards of organic farming. At the age of two years they are transported to a slaughterhouse within a radius of max. 200 km and get slaughtered.

Scenario 3: Stress-free on-farm slaughter

Dairy calves are separated from their dam after birth and fed cow's milk from buckets for three months. At the age of six to eight months, calves not intended for milk production are slaughtered stress-free on the farm where they were born and raised on. This way, the animals are not subjected to the stress associated with transport and slaughter at a slaughterhouse.

Subsequently, respondents' WTB was surveyed, serving as an indicator for the market potential. Therefore, the participants were required to imagine that milk and dairy products, as well as veal or beef products are available in supermarkets that originate from organic dairy farms dealing with surplus dairy calves in the way described in the scenario presented to them. The respondents were asked to indicate on two 7-point rating scales, ranging from 1 = "very unlikely" to 7 = "very likely", the likelihood that they would choose organic dairy and veal or beef products over other dairy and meat products despite a higher price. Vegetarian respondents who indicated that they would definitively abstain from meat consumption in the future were only queried about their WTB dairy products from these organic farms, but not about their WTB the organic meat products. Individuals who indicated that they do not consume milk/dairy products but meat and cannot imagine that this will change in the future were only asked about their

WTB the organic meat products mentioned. Finally, participants were presented with the other two scenarios, which they had not read before. They were asked to rate which scenario they like best/least by ranking them in order, starting with the scenario they liked best. In the last part of the questionnaire, sociodemographic data were obtained. Participants were inquired about their occupation, type of household, net household income, and whether they had pets.

Statistical analysis

Respondents who reported never being responsible for purchasing groceries for their household were excluded from the analysis. Only four participants stated that they follow a vegan diet, with all of them indicating no desire to consume dairy and/or meat products in the future. As the primary aim of this study is to investigate the WTB of consumers of dairy and/or meat products, all vegans were excluded from subsequent analyses. After these individuals were excluded, 911 cases remained. The demographic distribution of the final data set is shown in Table 1.

In order to identify different groups among consumers that differ in their attitudes and purchase intentions, an explorative factor analysis with subsequent hierarchical cluster analysis was performed. First, the principal component extraction model with varimax rotation was conducted including the variables shown in Table 2, which are related to participants' attitudes toward AW aspects in dairy calf management (12 items) and towards various aspects of grocery shopping (16 items). The suitability of the data set for factor analysis was confirmed by a Kaiser–Meyer–Olkin coefficient exceeding 0.8 (result: 0.953) and a significant Bartlett test of sphericity (result: < 0.001). To determine the reliability of the identified factors, Cronbach's α was calculated. Factors with a Cronbach's α value below the threshold of 0.6 are not reliable (Hair et al. 2019) and were therefore not used for further analysis. Afterwards, the mean scores of the items that load highly on the same factor were calculated. These newly generated variables were then used as cluster variables. First, the Single linkage method was conducted to identify outliers which were consequently excluded from further analytical steps. Next, a hierarchical clustering technique according to Ward's method was used. For both analyses, the squared Euclidean distance was chosen as the measure of proximity. By using graphical outputs (Dendrogram and Elbow graph) the appropriate number of clusters could be established. Since the cluster variables were not normally distributed, Kruskal–Wallis H test with Dunn's post-hoc analyses with Bonferroni correction for multiple comparisons was performed to verify the identified clusters. Cross tabulations were used to profile the clusters. For this purpose, several variables were inserted into the cross tables and were tested for a relationship to cluster affiliation. These variables concern the socio-demographic characteristics gender, age, occupation, as well as the type of household, the net household income, the diet and the presence of pets in the household. The examination of correlations between cluster affiliation and the aforementioned variables was conducted using Pearson's X^2-test, Cramer's

Table 1 Socio-demographic characteristics of the sample

	Sample	South-west Germany*
Gender ($n = 911$)		
female	52%	51%[a]
Age group ($n = 911$)		
below 25	9%	10%[a]
25–39	21%	23%[a]
40–64	44%	42%[a]
65 and above	27%	25%[a]
With children (n = 911)	25%	
Diet ($n = 911$)		
omnivore	78%	
pescatarian	1%	
flexitarian	17%	
vegetarian	3%	
no milk/dairy products but meat (products)	1%	
Net household income ($n = 821$)		
less than 1.300€	14%	
1.300€—below 2.600€	30%	
2.600€—below 3.600€	23%	
3.600€—below 5.000€	24%	
5.000€ and more	10%	
Pet(s) at home ($n = 911$)	43%	

*South-West Germany: Baden-Wuerttemberg, Rhineland-Palatinate, Hesse and Saarland

a = Federal Statistical Office (2021)

Source: Authors' own work

V-test and standardized residuals. Furthermore, it was analyzed whether the WTB organic dairy and meat products differ between the clusters. Therefore, the data set was split according to the scenario grouping. As the variables used to compare means were not normally distributed, the Kruskal–Wallis test was used again, followed by Dunn post-hoc analyses with Bonferroni correction for multiple comparisons. Cross-tabulations with Pearson's X^2-test, standardized residuals and Cramer's V were used to determine differences between clusters in the ranking of scenarios. Analyses were performed using IBM® SPSS statistical software, version 28.

Results

Factor analysis

As shown in Table 2, performing a principal component analysis with 28 items resulted in five factors. However, since the Cronbach's α value of factor 5 (items 26–28) was 0.549, which is below the threshold of 0.6, these items were not used in the subsequent cluster analysis. The following four factors have been identified and used for further analyses:

(1) AW in dairy calf management (factor 1)
(2) Importance of sustainable food production (factor 2)
(3) Importance of product quality (factor 3)
(4) WTB organic food (factor 4)

Each item is assigned to one of the factors with the corresponding factor loading. The first factor, AW in dairy calf management, includes all 12 items (items 1–12) related to participants' attitude towards the management of dairy calves. The second factor, importance of sustainable food production, contains 7 items that refer to participants' attitude towards sustainability aspects in food production when purchasing food (items 13–19). Although the item "buying healthy food" loads slightly higher on the second factor, it is assigned to the third factor as its content fits better with the other items of this factor. The third factor, importance of product quality, includes items indicating the importance participants place on taste, freshness and healthiness when purchasing food (items 20–22). Since the fourth factor, apart from the items related to the importance of buying organic food and the importance of organic associations, contains the item related to the amount of money paid for food, the factor was termed "WTB organic food" (items 23–25).

Hierarchical cluster analysis

Using the Single-linkage method, three outliers were identified and excluded, leaving 908 cases in total to be included in the Ward cluster analysis. Performing this cluster analysis resulted in four clusters:

Cluster 1: Conscious organic shoppers ($n = 347$)
Cluster 2: Moderate sustainability advocates ($n = 260$)
Cluster 3: The indifferent consumers ($n = 120$)
Cluster 4: Interested organic refusers ($n = 181$)

The results of the Kruskal–Wallis H test show that all four factors (see Table 2) that were used to form the clusters differ significantly between the found clusters: AW in dairy calf management ($H(3) = 434.974$, $p < 0.001$, $Mdn = 5.33$), Importance of sustainable food production ($H(3) = 548.851$, $p < 0.001$, $Mdn = 4.71$), Importance of product quality ($H(3) = 632.870$, $p < 0.001$, $Mdn = 5.33$) and WTB organic food ($H(3) = 331.536$, $p < 0.001$, $Mdn = 3.67$). The post-hoc comparisons also show that all clusters except one differ significantly ($p < 0.05$) with regard to these four factors. Only for AW in dairy calf management, Cluster 2 and Cluster 4 differ at a significance level of $p = 0.05$. Furthermore, as shown in Table 3, the results of the chi-square test indicate that there are significant differences between the clusters regarding participants' gender, age, net household income, occupation, household type and pet ownership.

Conscious organic shoppers (38%)

Participants assigned to the first cluster consider sustainability aspects in food production and high product quality when purchasing food, as well as the welfare of calves in dairy farming to be very important. They also have a high interest in purchasing organic food. There are significantly more women and elderly respondents (65 years or older) in this cluster. These individuals are also more likely to have a higher net household income

Table 2 Factor loadings with respect to the importance of animal welfare and food purchasing aspects

Factor loading					
	Factor 1 (α = 0.950)	Factor 2 (α = 0.865)	Factor 3 (α = 0.698)	Factor 4 (α = 0.716)	Factor 5 (α = 0.549)
1 Feeding the calves with maternal milk	0.831	0.186	0.072	0.022	0.095
2 Cow-calf contact	0.809	0.170	0.026	0.050	0.056
3 Calves have a long life	0.799	0.157	0.050	0.034	0.160
4 Avoiding stressful situations for calves	0.791	0.232	0.184	0.070	−0.012
5 A species-appropriate life of the dairy calves	0.786	0.220	0.187	0.111	−0.025
6 Calves can drink milk from the udder of a cow	0.784	0.181	0.050	0.013	0.145
7 Keeping cows and calves on the pasture	0.783	0.219	0.151	0.107	−0.020
8 Calves can be raised on the farm where they were born	0.764	0.237	0.010	0.026	0.102
9 Avoiding long-distance transportation of calves	0.741	0.226	0.130	0.108	−0.069
10 Calves stay in the local region	0.727	0.266	0.034	0.072	0.080
11 Calves' health	0.692	0.211	0.290	0.065	−0.057
12 Rearing calves from organic dairy cows according to organic principles	0.664	0.251	0.083	0.358	0.154
13 Buying products that have been produced under fair working conditions	0.324	0.750	0.018	0.140	0.046
14 Buying products produced in an environmentally friendly way	0.323	0.696	0.137	0.188	0.118
15 Knowing that I am doing something good with my purchase	0.286	0.665	−0.007	0.080	0.298
16 A traditional production of the products	0.198	0.640	0.067	−0.116	0.182
17 Buying local products	0.271	0.618	0.281	0.187	−0.020
18 Buying products from species-appropriate animal husbandry	0.387	0.606	0.133	0.288	0.005
19 Buying low-processed products	0.207	0.565	0.153	0.186	0.094
20 Buying healthy products	0.227	0.510	0.457	0.138	0.188
21 The taste	0.130	0.085	0.836	−0.010	−0.026
22 The freshness	0.240	0.276	0.732	0.019	0.048
23 Spending little money on the products *	0.061	0.067	0.040	0.757	−0.175
24 Buying organic products	0.162	0.448	0.041	0.664	0.295
25 Products from certain organic associations	0.176	0.404	−0.072	0.610	0.447
26 Buying products that friends of mine also buy	−0.014	0.251	−0.124	−0.132	0.727
27 Trying new products from time to time	0.093	−0.044	0.412	0.012	0.658
28 Buying products of a certain brand	0.116	0.337	−0.017	0.314	0.594

Bartlett test: < 0.001; Kaiser–Meyer–Olkin (KMO): 0.953; α = Cronbach's α; *item inverted.

Scales: 1 = 'very unimportant' to 6 = 'very important' (n = 911)

Source: Authors' own work

(5,000€ or more). They are significantly more likely to have a pet and follow a flexitarian diet.

Moderate sustainability advocates (29%)

Participants in the second cluster also consider product quality when purchasing food and calf welfare in dairy farming to be important, but attach less importance to sustainability aspects in their purchases. They have a moderate WTB organic food. The values hardly deviate from the overall average of the sample. This cluster includes significantly more often young people (under the age of 25) and people in apprenticeship/study. Members are also significantly more likely to live with their parents.

Table 3 Profiles of clusters

Cluster							
		Conscious organic shoppers ($n=347$)	Moderate sustainability advocates ($n=260$)	The indifferent consumers ($n=120$)	Interested organic refusers ($n=181$)	*p*-value	Cramer-V
Cluster-describing variables	*Gender*						
	female	62.5 (+)	50.4	34.2 (−)	45.3 (−)	< 0.001	0.194
	male	37.5 (−)	49.6	65.8 (+)	54.7(+)		
	Age Group						
	below 25 years	4.6 (−)	11.9 (+)	11.7	9.4	< 0.001	0.107
	25–39 years	19.3	22.3	30.8 (+)	14.9(−)		
	40–64 years	43.5	44.2	36.7	0.47		
	65 years and above	32.6 (+)	21.5 (−)	20.8	28.7		
	Net household income						
	less than 1.300€	8.8 (−)	15.1	12.7	21.0 (+)	0.023	0.098
	1.300€—below 2.600€	31.2	28.6	24.5	30.9		
	2.600€—below 3.600€	22.7	23.1	22.7	21.0		
	3.600€—below 5.000€	23.4	25.6	29.1	19.8		
	5.000€ and more	14.0 (+)	7.6	10.9	7.4		
	Occupation						
	student/apprentice	4.0 (−)	12.7 (+)	10.8	8.3	< 0.001	0.145
	employed	45.2	46.9	55 (+)	33.1 (−)		
	self-employed	6.6	3.8	5.0	6.6		
	housewife/househusband	6.1	5.4	2.5	1.7 (−)		
	retired	33.1	24.2 (−)	22.5 (−)	40.9(+)		
	mini-job	1.4	1.5	0.8	1.1		
	unemployed	0.9 (−)	3.1	3.3	5.0 (+)		
	other	2.6	2.3	0.0	3.3		
	Type of household						
	single	26.2	0,25	35.8 (+)	30.4	< 0.001	0.125
	single parent	1.4	3.1	1.7	3.3		
	couple without children	41.5	32.3 (−)	26.7(−)	44.8 (+)		
	couple with child/children	24.2	24.6	26.7	13.3 (−)		
	shared flat	5.8	9.6	7.5	5.5		
	parents' home	0.6 (−)	5.0 (+)	1.7	2.8		
	other	0.3	0.4	0.0	0.0		
	Diet						
	omnivore	70.0 (−)	81.2	86.7(+)	85.1 (+)	< 0.001	0.113
	pescatarian	1.7	1.2	0.0	2.2		
	flexitarian	24.5 (+)	14.6	0.1 (−)	8.3 (−)		
	vegetarian	2.9	2.3	1.7	2.8		
	no milk/dairy products but meat (products)	0.9	0.8	1.7	1.7		
	Pets						
	yes	49.9(+)	38.8	26.7 (−)	43.6	< 0.001	0.154
	no	50.1 (−)	61.2	73.3 (+)	56.4		

(+) Adjusted standardized residuals > 1.96. indicating that the subcategory was observed more frequently than expected. (-) Adjusted standardized residuals < 1.96. indicating that the subcategory was observed less frequently than expected

Source: Authors' own work

The indifferent consumers (13%)

Compared to the first two clusters, the welfare of calves from dairy farms is significantly less important to people in the third cluster. When buying food, they attach less importance to sustainability in food production. They also show a low WTB organic food. Product quality, on the other hand, is relatively important to them. This cluster include significantly more men between the ages of 25 and 39 years who are employed and live in a single household without pets. They are significantly more likely to follow an omnivorous diet and less likely to be flexitarian.

Interested organic refusers (20%)

The members of the fourth cluster mainly attach importance to the food product quality when buying food and are concerned about the welfare of calves in dairy farming. They attach moderate importance to sustainability in production when buying groceries. The WTB organic food is very low. This cluster includes significantly more men and participants with a net household income below 1,300€. Individuals between 25 and 49 years of age are less frequently represented in this cluster. In addition, there are significantly more pensioners and job seekers, less often employees and housewives/househusbands in this group. Furthermore, more couples without children and omnivores belong to this cluster.

WTB organic dairy and meat products

In total, both the "CCC system" group and the "dual-purpose breeds" group, participants indicated a similarly high WTB dairy (Mdn = 6.00) and veal or beef products (Mdn = 6.00). In the "on-farm slaughter" scenario, the overall WTB veal products was slightly lower (Mdn = 5.00) than for dairy products (Mdn = 6.00). Kruskal–Wallis H test results indicated significant differences with regard to participants WTB organic dairy and meat products between the clusters in all three scenarios (Figs. 1–3). The number of participants, categorized by scenario and cluster affiliation, is shown in Table 4.

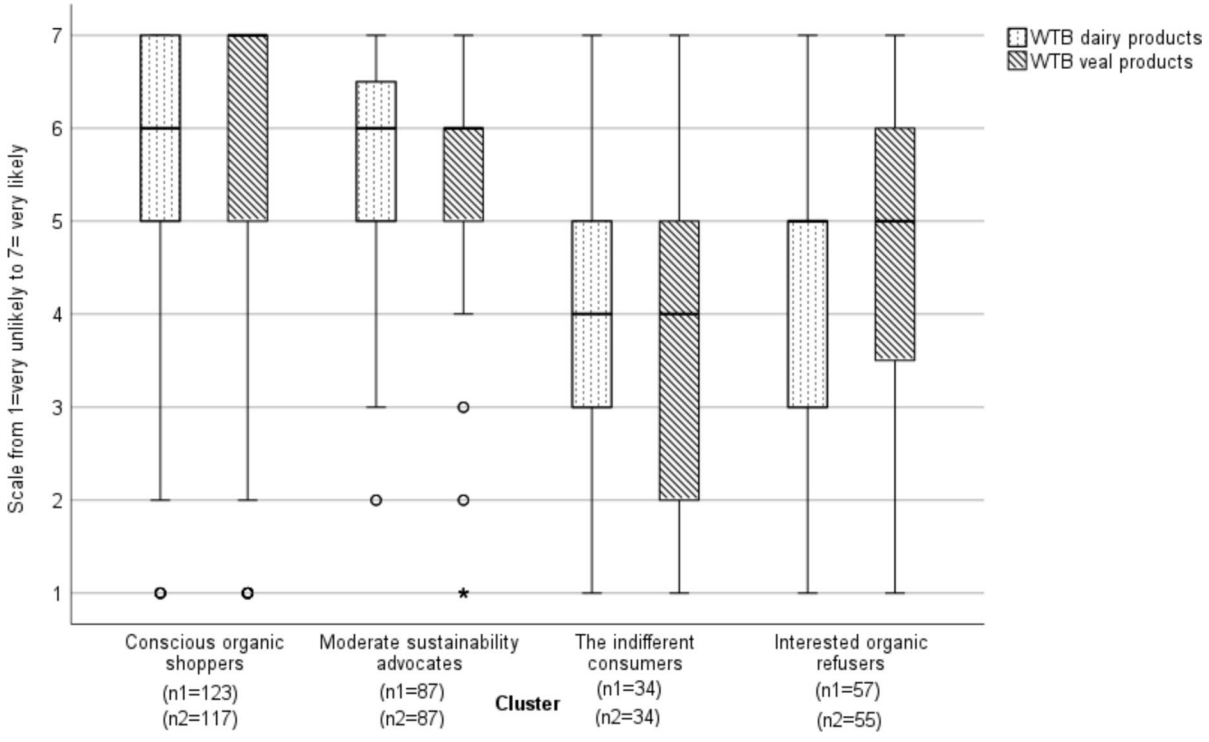

Fig. 1 Willingness to buy (WTB) organic dairy and veal products from cow-calf contact (CCC) systems for four different clusters. Notes: n1 = Number of participants who indicated their WTB organic dairy products; n2 = Number of participants who indicated their WTB organic veal products; The participants were asked to complete the following sentences by using the rating scale: "That I would prefer dairy products from these organic farms over other dairy products despite a higher price when buying food is….", "That I would prefer veal products from these organic farms over other meat products despite a higher price when buying food is…." (1 = very unlikely – 7 = very likely). Source: Authors' own work

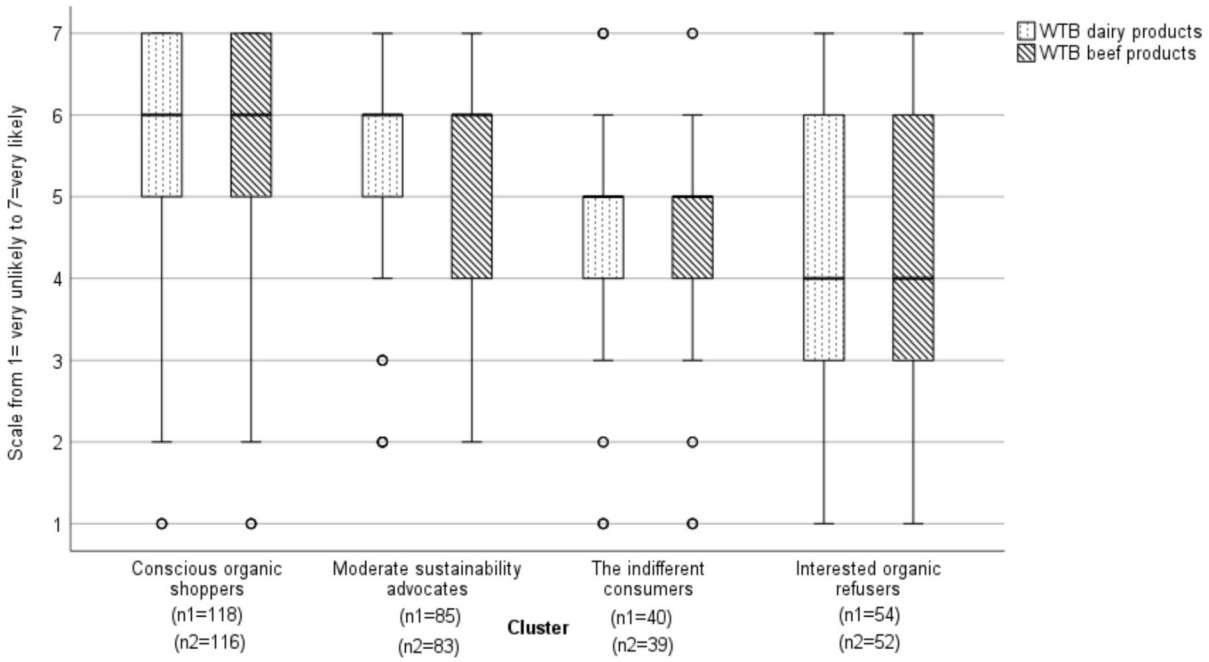

Fig. 2 Willingness to buy (WTB) organic dairy and beef products from dual-purpose breeds for four different clusters. Notes: Scales: n1 = Number of participants who indicated their WTB organic dairy products; n2 = Number of participants who indicated their WTB organic beef products; The participants were asked to complete the following sentences by using the rating scale: "That I would prefer dairy products from these organic farms over other dairy products despite a higher price when buying food is….", "That I would prefer beef products from these organic farms over other meat products despite a higher price when buying food is…." (1 = very unlikely – 7 = very likely). Source: Authors' own work

Scenario 1: CCC system

In the first scenario group, there are significant differences between clusters regarding participants' WTB organic dairy ($H(3) = 65.21$, $p < 0.001$) and veal ($H(3) = 48.98$, $p < 0.001$) products from farms that keep cows and calves together. The findings revealed that, Cluster 1 indicated the highest willingness to purchase milk and veal from the CCC system, followed by Cluster 2, Cluster 4 and finally, Cluster 3 (see Fig. 1). Post hoc pairwise comparisons show that there is no significant difference between Clusters 1 and 2 in terms of their WTB organic dairy products ($p = 0.116$). Furthermore, Clusters 3 and 4 do not differ significantly regarding their WTB organic dairy ($p = 1.000$) and veal ($p = 0.453$) products from the CCC system. Moreover, there is no significant difference between Cluster 2 and Cluster 4 concerning their WTB organic veal products from these farms ($p = 0.104$). Apart from the aforementioned cluster pairs, all other clusters differ significantly ($p < 0.05$) from each other in terms of their WTB organic dairy and veal products from these farms (Fig. 1).

Scenario 2: Dual-purpose breeds

The clusters in the "dual-purpose breeds" scenario group also differ significantly from each other in terms of their WTB organic dairy ($H(3) = 64.70$, $p < 0.001$) and beef products ($H(3) = 50.58$, $p < 0.001$). The highest WTB organic dairy and beef products from dual-purpose breeds was evident among participants in Cluster 1. Cluster 2 indicated the second-highest, Cluster 3 the third-highest and Cluster 4 the lowest WTB these products (see Fig. 2). The post-hoc pairwise comparisons show that cluster 1 differs significantly from all clusters in terms of their WTB these products ($p < 0.005$). In addition, Clusters 2 and 4 also differ significantly from each other in their WTB of these organic dairy ($p = 0.001$) and beef products ($p = 0.042$). The Clusters 3 and 4 do not differ significantly from each other regarding their

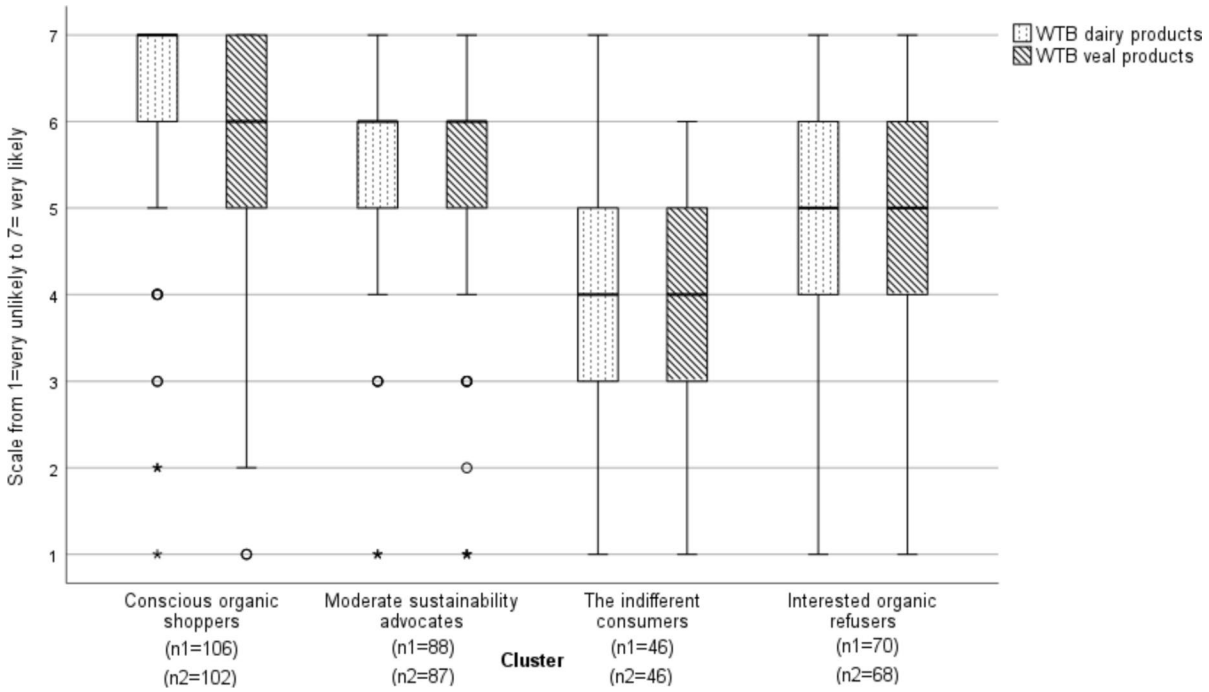

Fig. 3 Willingness to buy (WTB) organic dairy and veal products from on-farm slaughtering for four different clusters. Notes: Scales: n1 = Number of participants who indicated their WTB organic dairy products; n2 = Number of participants who indicated their WTB organic veal products; The participants were asked to complete the following sentences by using the rating scale: "That I would prefer dairy products from these organic farms over other dairy products despite a higher price when buying food is….", "That I would prefer veal products from these organic farms over other meat products despite a higher price when buying food is…." (1 = very unlikely – 7 = very likely). Source: Authors' own work

Table 4 Distribution of participants by clusters and scenario groups

Cluster						
		Conscious organic shoppers (*n*)	Moderate sustainability advocates (*n*)	The indifferent consumers (*n*)	Interested organic refusers (*n*)	Total (*n*)
Scenarios	CCC system	$123^a/123^b/117^c$	$87^a/87^b/87^c$	$34^a/34^b/34^c$	$57^a/57^b/55^c$	$301^a/301^b/293^c$
	Dual-purpose breeds	$118^a/118^b/116^c$	$85^a/85^b/83^c$	$40^a/40^b/39^c$	$54^a/54^b/52^c$	$297^a/297^b/290^c$
	On-farm slaughter	$106^a/106^b/102^c$	$88^a/88^b/87^c$	$46^a/46^b/46^c$	$70^a/70^b/68^c$	$310^a/310^b/303^c$
	Total	$347^a/347^b/335^c$	$260^a/260^b/257^c$	$120^a/120^b/119^c$	$181^a/181^b/175^c$	$908^a/908^b/886^c$

a = Total number of participants in cluster and scenario; b = Number of participants who indicated WTB for dairy products; c = Number of participants who indicated WTB for meat products; *CCC* Cow-calf contact

Source: Authors' own work

WTB organic dairy (p = 1.000) and beef (p = 1.000) products from dual-purpose breeds. There is also no significant difference concerning the WTB organic beef of dual-purpose breeds between the clusters 2 and 3 (p = 0.144).

Scenario 3: Stress-free on-farm slaughter

There are significant differences between clusters in the third scenario group (stress-free on-farm slaughter) with regard to their WTB organic

dairy ($H(3) = 88.32$, $p < 0.001$) and veal products ($H(3) = 79.58$, $p < 0.001$). The results revealed that Cluster 1 showed the highest WTB organic dairy and veal products from farms with on-farm slaughtering, followed by Cluster 2 and Cluster 4. Members of the third cluster indicated the lowest WTB these products (see Fig. 3). The post-hoc pairwise comparisons showed that only the Clusters 3 and 4 do not differ significantly from each other when it comes to their WTB organic dairy ($p = 0.232$) and veal products ($p = 0.256$) from these farms. All of the other clusters significantly differ from one another ($p < 0.05$).

Ranking of scenarios

As Table 5 shows, when asked which scenario they liked most and least, participants ranked the „CCC system " scenario first (51.7%), "on-farm slaughtering" scenario second (43.1%) and the "dual-purpose breeds" scenario third (62.9%). Results of the Chi-Square test indicate that participants in the third cluster put the scenario "dual-purpose breeds" significantly less often and the "CCC system" scenario more often into third place, compared to the other clusters. Individuals in Cluster 1, on the other hand, voted the "CCC system" scenario significantly less often in last place. There was a tendency, albeit not significant, that in Cluster 3 the scenario "dual-purpose breeds" was more frequently and the "CCC system" scenario less frequently ranked first than in the other clusters. In addition, Cluster 3 tended to rank the "on-farm slaughter" scenario less frequently in the second place.

Discussion

The findings indicate that, on average, participants ranked the "CCC system" scenario as the most favored of the scenarios presented. As previous studies have demonstrated that a significant proportion of the population rejects early

Table 5 Ranking of scenarios divided by clusters

Clusters								
		Conscious organic shoppers ($n = 347$)	Moderate sustainability advocates ($n = 260$)	The indifferent consumers ($n = 120$)	Interested organic refusers ($n = 181$)	Total	*p*-value	Cramer-V
Scenarios	*Percentage of first placements by cluster and scenario*							
	CCC system	55.6%	52.3%	40.8% (−)	50.3%	51.7%	0.085	0.078
	Dual-purpose breeds	11.8%	13.5%	20% (+)	11.0%	13.2%		
	On-farm slaughter	32.6%	34.2%	39.2%	38.7%	35.1%		
	Percentage of second placements by cluster and scenario							
	CCC system	32.9%	32.7%	35.8%	32.0%	33.0%	0.487	0.055
	Dual-purpose breeds	21.9%	23.8%	30.0%	23.8%	23.9%		
	On-farm slaughter	45.2%	43.5%	34.2% (−)	44.2%	43.1%		
	Percentage of third placements by cluster and scenario							
	CCC system	11.5% (−)	15.0%	23.3% (+)	17.7%	15.3%	0.013*	0.094
	Dual-purpose breeds	66.3%	62.7%	50% (−)	65.2%	62.9%		
	On-farm slaughter	22.2%	22.3%	26.7%	17.1%	21.8%		

*** Significance level established at $p < 0.001$. * significance level established at $p < 0.05$ according to Chi-Square test. (+) Adjusted standardized residuals > 1.96, indicating that the subcategory was observed more frequently than expected. (-) Adjusted standardized residuals < 1.96, indicating that the subcategory was observed less frequently than expected; *CCC* = Cow-calf contact

Source: Authors' own work

cow-calf separation (Busch et al. 2017; Cardoso et al. 2017; Hötzel et al. 2017), it is not surprising that the "CCC system" scenario was rated first. The second most preferred scenario was "on-farm slaughter", which is consistent with previous studies indicating that on-farm slaughter is perceived positively by the majority of people (Bayer et al. 2023; Hoeksma et al. 2017). The "dual-purpose breeds" scenario was voted into last place. Given the relatively high WTB the products from this scenario, the overall assessment of this scenario appears positive, which is in line with the results of former studies showing that consumers value the use of these breeds (Schulze et al. 2023, 2021). While Ritter et al. (2022) highlight that a long and meaningful life for calves is valued by the majority of consumers, the ranking suggests that a longer lifespan alone is insufficient to guarantee higher perceived animal welfare. However, the comparison with Ritter et al. (2022) is limited as their study examined consumers' attitudes towards the slaughter of calves aged 2 weeks and 1 year, which are not directly comparable with the slaughter ages of 6–8 months and 2 years in the present study. Nonetheless, the ranking results may reflect consumers' prioritization of other welfare issues, such as natural behavior (e.g. CCC) and avoidance of stress associated with long-distance transport, over increased longevity. Furthermore, the lack of detailed information on the conditions during the extended fattening period, an inadequate explanation of the welfare benefits of using dual-purpose breeds and the fact that the animals were transported twice may have led consumers to perceive this scenario as less favorable than the other two scenarios. Hence, the advantages for animal welfare may have been unclear and have therefore evoked a weaker emotional response from consumers than the other two scenarios.

The findings of the present study regarding the high importance of product quality are in line with the results of the German Nutrition Report of the BMEL (2023), which highlights taste as a key factor in food choice. Similarly, Ammann et al. (2024) identified hedonic attributes, such as freshness, quality/taste and healthiness, as the most important product attributes in purchasing decisions for meat and dairy products. Furthermore, consistent with the German Nutrition Report of the BMEL (2023) and Ammann et al. (2024), the findings of this study indicate that consumers place greater importance on animals' rearing environment than on environmental sustainability. Sustainable food production was valued more highly than organic production, a preference also reflected in the findings of Ammann et al. (2024).

Identified clusters

To identify potential target groups for organic dairy and meat products from "calf-friendly" farms, a cluster analysis was conducted, resulting in four distinctly different clusters.

The first cluster's high WTB organic dairy and meat products across all three scenarios is consistent with previous studies indicating that consumers who are concerned about AW and the environment have a higher WTP for animal-friendly (Frey and Pirscher 2018) and organically produced food (Bravo et al. 2013; Wojciechowska-Solis and Barska 2021). The high proportion of women, flexitarians and pet owners in this cluster is also in line with the findings of previous research that have found a link between concern for AW and female gender (Blanc et al. 2020; Heise and Theuvsen 2017; Kupsala et al. 2015), pet ownership (Boogaard et al. 2006; Clark et al. 2016; Pirsich et al. 2017) and lower meat consumption (De Backer and Hudders 2015; Lund et al. 2016; Pfeiler and Egloff 2018; Rothgerber 2015). Furthermore, the finding that members of this cluster have a higher net household income is in accordance with previous research indicating a positive and statistically significant association between income level and the WTP for animal-friendly (see review by Boaitey and Minegishi 2020) and organic food (Dimitri and Dettmann 2012; Hansmann et al. 2020; Sivathanu 2015). The first cluster is comparable to a target group for meat from alternative slaughter methods identified by Bayer et al. (2023), which also consists of older people with higher incomes who prioritize AW, rarely consume meat, but have the highest organic meat consumption. The fact that members of this cluster tend to place a higher value on the CCC system might be attributed to a greater proportion of women and older individuals who may have children that no longer live with their parents in this cluster. Busch et al. (2017) reported that women and parents prefer the late separation of cow and calf and assume that the topic of

cow-calf separation reminds parents (especially mothers) of their relationship with their own children.

The high WTB organic milk and meat from "calf-friendly" farms in Cluster 2 reflects participants' high interest in AW in dairy calf management and high-quality products. On the other hand, these findings seem to contradict their previously stated rather mediocre willingness to purchase sustainably and organically produced food. However, the result of the factor analysis, which shows that the WTB organic food is a separate factor, suggests that consumers do not necessarily equate organic food with animal welfare and sustainability. Participants in this cluster may believe that calves can have a good life on conventional farms. Another potential explanation is that individuals in this group may have fewer financial resources to buy sustainable or organically produced food, given that this cluster comprises a greater proportion of individuals below the age of 25, often in apprenticeships or studies and living with their parents. No correlation was found between net household income and membership in the second cluster, probably because individuals in this cluster often live with their parents, affecting their reported household income. When shopping for the family, parents' income and attitudes, which were not surveyed, might influence participants' food purchase decisions.

The third cluster is in contrast to Cluster 1 concerning attitudes, gender, diet and pet ownership. Furthermore, this cluster contains more often individuals between 25 and 39 years old, who are employed, and live in a single household. Participants in Cluster 3 indicated the lowest WTB organic dairy and meat products in the "CCC system" and the "on-farm-slaughtering" scenarios. These results are consistent with earlier research findings showing that men generally consume more meat, especially red meat, than women (De Backer and Hudders 2015; Lund et al. 2016; Peeters et al. 2023; Rothgerber 2013). In addition, men are less interested in buying organic food (Sivathanu 2015), less concerned about environmental protection (see review by Ruby 2012) and AW (Blanc et al. 2020; Heise and Theuvsen 2017; Kupsala et al. 2015) and therefore less willing to pay for AW products (see review by Boaitey and Minegishi 2020). Interestingly, compared to the other clusters, the members of Cluster 3 put the "CCC system" scenario more frequently and the "dual-purpose breeds" scenario less frequently in third place in the ranking. As those individuals seem to be less emotionally involved when it comes to AW in dairy calf management, they presumably opt more often for the more rational than emotional approach. The slightly more positive attitude towards the "dual-purpose breeds" scenario is also reflected by the fact that this is the only scenario in which Cluster 3 does not show the lowest WTB organic dairy and meat products from "calf-friendly" organic dairy farms. Nevertheless, the WTB is rather moderately high.

Contrary to the third cluster, the low WTB organic dairy and meat products across all three scenarios in Cluster 4 does not appear to be a result of a lack of interest, but a lack of financial means. The high proportion of individuals with a low net household income (below €1,300), unemployed persons, and pensioners explains why members of this cluster attach little importance to sustainability and organic farming when purchasing foods, but place a greater emphasis on AW in the management of dairy calves. The latter refers solely to their attitude, not to their shopping behavior. Although concerned about calf welfare, their low income likely prevents them from buying sustainable and animal-friendly produced foods, despite these aspects being important to them. This is consistent with the findings of the literature review conducted by Boaitey and Minegishi (2020), showing a positive correlation between consumers' income and their WTP for farm animal welfare, as those with a higher income have a greater capacity to pay. In addition, the results of Hansmann et al. (2020) indicate that a lack of financial resources is a significant barrier to the purchase of organic food products. The positive attitude towards AW aspects in dairy calf management, coupled with a lack of financial resources, explains the moderately high willingness to purchase organic dairy and meat from "calf-friendly" farms, although this group indicates the lowest WTB organic food. Given no price was mentioned in the survey, it is likely that in a real shopping situation, individuals in this cluster would not choose products from "calf-friendly" dairy farms.

The results of the present study suggest that consumers with the characteristics of the first and largest cluster represent a promising target group for organic dairy and meat products from "calf-friendly" farms. The "CCC system" scenario was particularly well received. People in the second cluster might also be a potential target group for organic dairy and meat

products from "calf-friendly" farms, especially for products from CCC systems, but their actual WTB/WTP needs to be researched in future studies. Due to the lack of interest in Cluster 3 and the financial restrictions in Cluster 4, these consumer segments are unsuitable as target groups. As already suggested by Lauterbach et al. (2023) regarding meat from on-farm slaughter, the marketing of products from "calf-friendly" organic dairy farming should target less price-sensitive consumers in the premium segment of the market. The results of the present study indicate that the WTB depends more on consumers' general attitude and financial means than on the strategy presented to them. Products from organic dairy farms implementing emotionally appealing strategies, such as dam rearing, are likely to have relatively high market potential compared to other approaches. However, the market success of these products will presumably depend on the product prices. Hence, to improve the welfare of organic dairy calves in the long term, the additional costs for farmers as well as the product prices for consumers must remain within acceptable limits. As product quality was more important than all other factors in all clusters, sensory and health aspects must also be taken into account when marketing these products.

Limitations

Several limitations must be considered when interpreting the results. This study is limited to organic dairy farms and their products, which may differ from that of conventional dairy farm products. It should be noted that the provision of information in advance regarding the issue of surplus dairy calves and a potential solution strategy may have influenced participants' responses concerning their WTB. The scenarios are hypothetical and differ not only in the strategies implemented but also in other aspects. While the descriptions of the calves' lives allow comparisons of consumer attitudes within each scenario group, comparisons across scenarios are limited. Consequently, it is uncertain which specific aspects of the scenarios influenced participants' evaluations and to what extent. In addition, participants were not given a specific price for the products, which might have distorted the results. Hence, consumers' WTP may differ from the WTB analyzed in this study. It should also be taken into account that the concerns expressed by citizens about AW do not always align with consumers' actual purchasing behavior (Busch and Spiller 2020). Although significant differences were found between the clusters, it must be noted that the effect sizes are small.

Conclusion

The dairy industry faces major challenges in relation to the welfare of surplus dairy calves. In order to maintain its social license to produce, it is necessary to seek out alternative approaches to the management of these calves that align with consumer values and attitudes. The objective of the present study was to identify potential target groups for organic dairy and meat products from farms that implemented one of three different rearing systems with the aim to improve the welfare of surplus dairy calves. The findings indicate that the most preferred rearing system is to keep cow and calf together, followed by stress-free on-farm slaughter. The use of dual-purpose breeds was least favored by most participants. Organic consumers who care about dairy calves' welfare and prioritize product quality as well as sustainability aspects when purchasing food are a promising target group for these dairy and meat products. Limited financial resources appear to be a significant barrier to purchasing these products, therefore the marketing of organic "calf-friendly" dairy and meat products needs to be targeted at less price-sensitive consumers. These results can contribute to the development of more targeted marketing concepts for organic dairy and meat products from dairy farms implementing strategies to improve the fate of surplus calves. Nevertheless, future research is required to gain a more profound comprehension of consumers' WTB and WTP for organic dairy and meat products from "calf-friendly" farms. Therefore, further investigations are needed to examine consumers' behavior in actual purchasing situations.

Author Contribution The corresponding author, Mareike Herrler, and Prof. Stroebele-Benschop designed and conducted the study. Mareike Herrler analyzed and interpreted the data and wrote the draft. Prof. Stroebele-Benschop and Prof. Chagunda critically reviewed and revised the manuscript.

Funding Open Access funding enabled and organized by Projekt DEAL. This paper was written as part of the project "WertKalb", which is funded by the Ministry of Science, Research and Arts Baden-Wuerttemberg. The present study has

been approved by the Ethics Committee of the University of Hohenheim, Germany.

Data Availability The release of the data to third parties would contravene the data protection agreements that have been established with the participants in this study. Consequently, the data record cannot be made accessible to the public.

Declarations

Competing interests The authors declare no competing interests.

References

Ammann J, Mack G, El Benni N, Jin S, Newell-Price P, Tindale S, Hunter E, Vicario-Modroño V, Gallardo-Cobos R, Sánchez-Zamora P, Miškolci S, Frewer LJ (2024) Consumers across five European countries prioritise animal welfare above environmental sustainability when buying meat and dairy products. Food Qual Preference 117:105179

Bayer E, Busch G, Spiller A, Kühl S (2023) Pasture shooting and mobile slaughterhouses from a consumer's point of view: alternative slaughter methods and the meat paradox. Br Food J 125:4123–4142. https://doi.org/10.1108/BFJ-02-2023-0107

Beldad A, Hegner S (2020) A steak for supper if the cow did not suffer: understanding the mechanisms behind people's intention to purchase animal welfare-friendly (AWF) meat products. J Agric Environ Ethics 33:461–486. https://doi.org/10.1007/s10806-020-09834-z

Bertelsen M, Vaarst M (2023) Shaping cow-calf contact systems: Farmers' motivations and considerations behind a range of different cow-calf contact systems. J Dairy Sci 106:7769–7785. https://doi.org/10.3168/jds.2022-23148

Blanc S, Massaglia S, Borra D, Mosso A, Merlino VM (2020) Animal welfare and gender: a nexus in awareness and preference when choosing fresh beef meat? Ital J Anim Sci 19:410–420. https://doi.org/10.1080/1828051X.2020.1747952

BMEL (2023) Ernährungsreport 2023: Ergebnisse einer repräsentativen Bevölkerungsbefragung [Nutrition Report 2023: Results of a representative population survey]. https://www.bmel.de/DE/themen/ernaehrung/ernaehrungsreport2023.html. Accessed 13 June 2023

BMJV (1972) Tierschutzgesetz in der Fassung der Bekanntmachung (Animal Welfare Act as amended by the notice) vom 18. Mai 2006 (BGBl. I S. 1206, 1313), das zuletzt durch Artikel 1 des Gesetzes vom 17. Dezember 2018 (BGBl. I S. 2586) geändert worden ist. https://www.gesetze-im-internet.de/tierschg/BJNR012770972.html#BJNR012770972BJNG000303377. Accessed 20 Dec 2022

Boaitey A, Minegishi K (2020) Who are farm animal welfare conscious consumers? Br Food J 122:3779–3796. https://doi.org/10.1108/BFJ-08-2019-0634

Boaitey A, Lai Y, Kehoe S (2022) The value of additional calf–mother contact in milk choice: an analysis of US consumers. Renew Agric Food Syst 37:683–694. https://doi.org/10.1017/S1742170522000333

Bolton SE, von Keyserlingk MAG (2021) The dispensable surplus dairy calf: is this issue a "wicked problem" and where do we go from here? Front Vet Sci 8:660934. https://doi.org/10.3389/fvets.2021.660934

Bolton SE, Vandresen B, von Keyserlingk MA (2024) Waste not, want not: value chain stakeholder attitudes to surplus dairy calf management in Australia. Anim Welf 33:e10. https://doi.org/10.1017/awf.2024.4

Boogaard BK, Oosting SJ, Bock BB (2006) Elements of societal perception of farm animal welfare: a quantitative study in The Netherlands. Livest Sci 104:13–22. https://doi.org/10.1016/j.livsci.2006.02.010

Bravo CP, Cordts A, Schulze B, Spiller A (2013) Assessing determinants of organic food consumption using data from the German National Nutrition Survey II. Food Qual Prefer 28:60–70. https://doi.org/10.1016/j.foodqual.2012.08.010

Busch G, Spiller A (2020) Warum wir eine Tierschutzsteuer brauchen – Die Bürger-Konsumenten-Lücke [Why we need an animal welfare tax - the citizen-consumer gap]. http://hdl.handle.net/10419/214180. Accessed 20 June 2024

Busch G, Weary DM, Spiller A, von Keyserlingk MAG (2017) American and German attitudes towards cow-calf separation on dairy farms. PLoS ONE 12:e0174013. https://doi.org/10.1371/journal.pone.0174013

Cardoso CS, von Keyserlingk MAG, Hötzel MJ (2017) Brazilian citizens: expectations regarding dairy cattle welfare and awareness of contentious practices. Animals 7. https://doi.org/10.3390/ani7120089

Carlsson F, Frykblom P, Lagerkvist CJ (2007) Consumer willingness to pay for farm animal welfare: mobile abattoirs versus transportation to slaughter. Eur Rev Agric Econ 34:321–344. https://doi.org/10.1093/erae/jbm025

Christoph-Schulz I, Rovers A, Luy J (2019) Fairer Deal?! Zwischen verbesserter Tierhaltung und günstigen Lebensmittelpreisen: [Fair deal?! Between improved animal husbandry and low food prices]. 29. Jahrbuch der Österreichischen Gesellschaft für Agrarökonomie, pp 23–24

Clark B, Stewart GB, Panzone LA, Kyriazakis I, Frewer LJ (2016) A systematic review of public attitudes,

perceptions and behaviours towards production diseases associated with farm animal welfare. J Agric Environ Ethics 29:455–478. https://doi.org/10.1007/s10806-016-9615-x

Clark B, Stewart GB, Panzone LA, Kyriazakis I, Frewer LJ (2017) Citizens, consumers and farm animal welfare: a meta-analysis of willingness-to-pay studies. Food Policy 68:112–127. https://doi.org/10.1016/j.foodpol.2017.01.006

Creutzinger K, Pempek J, Habing G, Proudfoot K, Locke S, Wilson D, Renaud D (2021) Perspectives on the management of surplus dairy calves in the United States and Canada. Front Vet Sci 8:661453. https://doi.org/10.3389/fvets.2021.661453

De Backer CJS, Hudders L (2015) Meat morals: relationship between meat consumption consumer attitudes towards human and animal welfare and moral behavior. Meat Sci 99:68–74. https://doi.org/10.1016/j.meatsci.2014.08.011

Dimitri C, Dettmann RL (2012) Organic food consumers: what do we really know about them? Br Food J 114:1157–1183. https://doi.org/10.1108/00070701211252101

EFSA Panel on Animal Health and Welfare (2022) Welfare of cattle during transport. EFSA J 20:e07442. https://doi.org/10.2903/j.efsa.2022.7442

Eriksen MS, Rødbotten R, Grøndahl AM, Friestad M, Andersen IL, Mejdell CM (2013) Mobile abattoir versus conventional slaughterhouse—Impact on stress parameters and meat quality characteristics in Norwegian lambs. Appl Anim Behav Sci 149:21–29. https://doi.org/10.1016/j.applanim.2013.09.007

Eriksson H, Fall N, Ivemeyer S, Knierim U, Simantke C, Fuerst-Waltl B, Winckler C, Weissensteiner R, Pomiès D, Martin B, Michaud A, Priolo A, Caccamo M, Sakowski T, Stachelek M, Spengler Neff A, Bieber A, Schneider C, Alvåsen K (2022) Strategies for keeping dairy cows and calves together - a cross-sectional survey study. Animal 16:100624. https://doi.org/10.1016/j.animal.2022.100624

Federal Statistical Office (2021) Bevölkerung: Bundesländer, Stichtag, Geschlecht, Altersjahre (12411–0013) [Population: states, reference date, sex, age (12411–0013)]. https://www-genesis.destatis.de/genesis/online#astructure. Accessed 4 Feb 2022

Fraser D (2009) Assessing animal welfare: different philosophies, different scientific approaches. Zoo Biol 28:507–518. https://doi.org/10.1002/zoo.20253

Frey UJ, Pirscher F (2018) Willingness to pay and moral stance: the case of farm animal welfare in Germany. PLoS ONE 13:e0202193. https://doi.org/10.1371/journal.pone.0202193

Goetz HM, Kelton DF, Costa JHC, Winder CB, Renaud DL (2021) Identification of biomarkers measured upon arrival associated with morbidity, mortality, and average daily gain in grain-fed veal calves. J Dairy Sci 104:874–885. https://doi.org/10.3168/jds.2020-18729

Hair JF, Black WC, Babin BJ, Anderson RE (2019) Multivariate data analysis, 8th edn. Cengage, Andover

Hansmann R, Baur I, Binder CR (2020) Increasing organic food consumption: an integrating model of drivers and barriers. J Clean Prod 275:123058. https://doi.org/10.1016/j.jclepro.2020.123058

Haskell MJ (2020) What to do with surplus dairy calves? welfare, economic, and ethical considerations. Landbauforsch 70:45–48

Heise H, Theuvsen L (2017) What do consumers think about farm animal welfare in modern agriculture? Attitudes and shopping behaviour. Int Food Agribus Manag Rev 20:379–399. https://doi.org/10.22434/IFAMR2016.0115

Herrler M, Chagunda MGG, Stroebele-Benschop N (2023) Public awareness, attitude and empathy regarding the management of surplus dairy calves. J Agric Environ Ethics 36:11. https://doi.org/10.1007/s10806-023-09905-x

Hoeksma DL, Gerritzen MA, Lokhorst AM, Poortvliet PM (2017) An extended theory of planned behavior to predict consumers' willingness to buy mobile slaughter unit meat. Meat Sci 128:15–23. https://doi.org/10.1016/j.meatsci.2017.01.011

Hötzel MJ, Cardoso CS, Roslindo A, von Keyserlingk MAG (2017) Citizens' views on the practices of zero-grazing and cow-calf separation in the dairy industry: does providing information increase acceptability? J Dairy Sci 100:4150–4160. https://doi.org/10.3168/jds.2016-11933

Huuskonen A, Pesonen M, Kämäräinen H, Kauppinen R (2013) A comparison of the growth and carcass traits between dairy and dairy × beef breed crossbred heifers reared for beef production. J Anim Feed Sci 22:188–196

Hyde RM, Green MJ, Sherwin VE, Hudson C, Gibbons J, Forshaw T, Vickers M, Down PM (2020) Quantitative analysis of calf mortality in Great Britain. J Dairy Sci 103:2615–2623. https://doi.org/10.3168/jds.2019-17383

Kälber T, Barth K (2014) Practical implications of suckling systems for dairy calves in organic production systems - a review. Landbauforsch 64:45–58. https://doi.org/10.3220/LBF_2014_45-58

Kupsala S, Vinnari M, Jokinen P, Räsänen P (2015) Citizen attitudes to farm animals in finland: a population-based study. J Agric Environ Ethics 28:601–620. https://doi.org/10.1007/s10806-015-9545-z

Lauterbach J, Bruns AJ, Häring AM (2023) Exploring consumer preference towards the on-farm slaughtering of beef in Germany: a discrete choice experiment. Foods 12:3473. https://doi.org/10.3390/foods12183473

Lund V (2006) Natural living—a precondition for animal welfare in organic farming. Livest Sci 100:71–83. https://doi.org/10.1016/j.livprodsci.2005.08.005

Lund TB, McKeegan DEF, Cribbin C, Sandøe P (2016) Animal ethics profiling of vegetarians, vegans and meat-eaters. Anthrozoös 29:89–106. https://doi.org/10.1080/08927936.2015.1083192

Marcato F, van den Brand H, Kemp B, Engel B, Schnabel SK, Hoorweg FA, Wolthuis-Fillerup M, van Reenen K (2022) Effects of transport age and calf and maternal characteristics on health and performance of veal calves. J Dairy Sci 105:1452–1468. https://doi.org/10.3168/jds.2021-20637

Meagher RK, Beaver A, Weary DM, von Keyserlingk MAG (2019) Invited review: a systematic review of the effects of prolonged cow-calf contact on behavior, welfare, and productivity. J Dairy Sci 102:5765–5783. https://doi.org/10.3168/jds.2018-16021

Nielsen B, Thamsborg SM (2002) Dairy bull calves as a resource for organic beef production: a farm survey in Denmark. Livest Prod Sci 75:245–255. https://doi.org/10.1016/S0301-6226(01)00322-0

Peeters A, Ouvrein G, Dhoest A, De Backer C (2023) It's not just meat, mate! The importance of gender differences in meat consumption. Food Cult Soc 26:1193–1214. https://doi.org/10.1080/15528014.2022.2125723

Pfeiler TM, Egloff B (2018) Personality and attitudinal correlates of meat consumption: results of two representative German samples. Appetite 121:294–301. https://doi.org/10.1016/j.appet.2017.11.098

Pfuhl R, Bellmann O, Kühn C, Teuscher F, Ender K, Wegner J (2007) Beef versus dairy cattle: a comparison of feed conversion, carcass composition, and meat quality. Arch Anim Breed 50:59–70. https://doi.org/10.5194/aab-50-59-2007

Pirsich W, Hardenberg LM von, Theuvsen L (2017) The pet food industry: an innovative distribution channel for marketing feed products from welfare friendly production to consumers? Int J Food Syst Dyn 8:250–261. https://doi.org/10.18461/ijfsd.v8i3.836

Placzek M, Christoph-Schulz I, Barth K (2021) Public attitude towards cow-calf separation and other common practices of calf rearing in dairy farming—a review. Org Agric 11:41–50. https://doi.org/10.1007/s13165-020-00321-3

Reiber C, Wollmeister M, Sommer T, Chagunda MGG (2020) Status quo und Determinanten der Kälbervermarktung von ökologischen und konventionellen Milchviehbetrieben in Baden-Württemberg: [Status quo and determinants of calf marketing of organic and conventional dairy farms in Baden-Wuerttemberg]. Züchtungskunde 92:320–338

Renaud DL, Duffield TF, LeBlanc SJ, Haley DB, Kelton DF (2017) Management practices for male calves on Canadian dairy farms. J Dairy Sci 100:6862–6871. https://doi.org/10.3168/jds.2017-12750

Renaud DL, Duffield TF, LeBlanc SJ, Ferguson S, Haley DB, Kelton DF (2018) Risk factors associated with mortality at a milk-fed veal calf facility: A prospective cohort study. J Dairy Sci 101:2659–2668. https://doi.org/10.3168/jds.2017-13581

Rezagholivand A, Nikkhah A, Khabbazan MH, Mokhtarzadeh S, Dehghan M, Mokhtabad Y, Sadighi F, Safari F, Rajaee A (2021) Feedlot performance, carcass characteristics and economic profits in four Holstein-beef crosses compared with pure-bred Holstein cattle. Livest Sci 244:104358. https://doi.org/10.1016/j.livsci.2020.104358

Ritter C, Hötzel MJ, von Keyserlingk MG (2022) Public attitudes toward different management scenarios for "surplus" dairy calves. J Dairy Sci 105:5909–5925. https://doi.org/10.3168/jds.2021-21425

Rothgerber H (2013) Real men don't eat (vegetable) quiche: Masculinity and the justification of meat consumption. Psychol Men Masculin 14:363–375. https://doi.org/10.1037/a0030379

Rothgerber H (2015) Underlying differences between conscientious omnivores and vegetarians in the evaluation of meat and animals. Appetite 87:251–258. https://doi.org/10.1016/j.appet.2014.12.206

Ruby MB (2012) Vegetarianism. A Blossoming Field of Study. Appetite 58:141–150. https://doi.org/10.1016/j.appet.2011.09.019

Schulze M, Spiller A, Risius A (2021) Do consumers prefer pasture-raised dual-purpose cattle when considering meat products? A hypothetical discrete choice experiment for the case of minced beef. Meat Sci. 177:108494. https://doi.org/10.1016/j.meatsci.2021.108494

Schulze M, Kühl S, Busch G (2023) We have some calves left! socially accepted alternatives to the current handling of male calves from dairy production. Food Ethics 8:1–14. https://doi.org/10.1007/s41055-023-00122-w

Sirovica LV, Ritter C, Hendricks J, Weary DM, Gulati S, von Keyserlingk MAG (2022) Public attitude toward and perceptions of dairy cattle welfare in cow-calf management systems differing in type of social and maternal contact. J Dairy Sci 105:3248–3268. https://doi.org/10.3168/jds.2021-21344

Sirovnik J, Barth K, de Oliveira D, Ferneborg S, Haskell MJ, Hillmann E, Jensen MB, Mejdell CM, Napolitano F, Vaarst M, Verwer CM, Waiblinger S, Zipp KA, Johnsen JF (2020) Methodological terminology and definitions for research and discussion of cow-calf contact systems. J Dairy Res 87:108–114. https://doi.org/10.1017/S0022029920000564

Sivathanu B (2015) Factors affecting consumer preference towards the organic food purchases. Ind J Sci Technol 8:1–6. https://doi.org/10.17485/ijst/2015/v8i33/78261

Ventura BA, von Keyserlingk MAG, Schuppli CA, Weary DM (2013) Views on contentious practices in dairy farming: The case of early cow-calf separation. J Dairy Sci 96:6105–6116. https://doi.org/10.3168/jds.2012-6040

Vetouli T, Lund V, Kaufmann B (2012) Farmers' attitude towards animal welfare aspects and their practice in organic dairy calf rearing: a case study in selected Nordic farms. J Agric Environ Ethics 25:349–364. https://doi.org/10.1007/s10806-010-9301-3

Webb LE, Marcato F, Bokkers EAM, Verwer CM, Wolthuis-Fillerup M, Hoorweg FA, van den Brand H, Jensen MB, van Reenen CG (2022) Impact of early dam contact on veal calf welfare. Sci Rep 12:22144. https://doi.org/10.1038/s41598-022-25804-z

Webb LE, Verwer C, Bokkers EAM (2023) The future of surplus dairy calves – an animal welfare perspective.

Front. Anim. Sci. 4:1228770. https://doi.org/10.3389/fanim.2023.1228770

Wenker ML, van Reenen CG, Bokkers EA, McCrea K, de Oliveira D, Sørheim K, Cao Y, Bruckmaier RM, Gross JJ, Gort G, Verwer CM (2022) Comparing gradual debonding strategies after prolonged cow-calf contact: Stress responses, performance, and health of dairy cow and calf. Appl Anim Behav Sci 253:105694

Wojciechowska-Solis J, Barska A (2021) Exploring the preferences of consumers' organic products in aspects of sustainable consumption: the case of the polish consumer. Agric 11:138. https://doi.org/10.3390/agriculture11020138

Yang J-M (2023) Willingness to buy animal welfare products: a study on the conflict between moral attitudes and perceived higher prices. J Appl Anim Res 51:447–455. https://doi.org/10.1080/09712119.2023.2225586

Yeh C-H, Hartmann M (2021) To purchase or not to purchase? Drivers of consumers' preferences for animal welfare in their meat choice. Sustainability 13:9100. https://doi.org/10.3390/su13169100

Yue M, Jin S, Tindale S, Vicario-Modroño V, Sánchez-Zamora P, Gallardo-Cobos R, Newell-Price P, Frewer LJ (2024) Segmenting consumers of meat and dairy products from five European countries: Implications for promoting sustainable food choices. Sustain Prod Consumption 47:47–58. https://doi.org/10.1016/j.spc.2024.03.034

Zanon T, Degano L, Gauly M, Sartor P, Cozzi G (2023) Case study of the market situation of calves from Alpine dairy farms and the effect of dams' grazing during the last three months of gestation on auction parameters. Ital J Anim Sci 22:925–933. https://doi.org/10.1080/1828051X.2023.2251988