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Perceptions of stakeholders towards sheep and goat dairy products in Benin

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ABSTRACT

In Benin, small ruminant farming is practiced by a significant proportion of agricultural households, mainly for meat production but also for dairy production, which unfortunately is not yet valued. In this context, it is essential to understand the perceptions of breeders, processors, traders and consumers regarding sheep and goat dairy products in order to propose solutions to encourage better use of their animals' milk. To this end, a cross-sectional survey was conducted in twelve departments of the country in order to study the perceptions of stakeholders involved in the "milk and dairy products" value chain. A total of 1,198 actors were interviewed through a form and the results analyzed by descriptive statistics tools. Only 15.8% of breeders practice milking sheep and goats while the milk produced is mainly used for animal feed and personal consumption. 28% of breeders prefer to consume raw milk, while only a minority (27%) agree to process the milk produced. Among dairy product processors, only 6.25% from the Couffo department already process small ruminant milk and depending on the department, 20 to 100% of respondents say they are ready to process sheep or goat milk. The vast majority of traders (99%) do not yet distribute their products given the low demand and their availability on the market. Furthermore, the majority of the latter were in favor of their commercialization if the demand was felt on the consumer market. Finally, the majority of the people surveyed (67.31% to 100%) consume dairy products made from cow's milk. They are reluctant to consume dairy products from small ruminants because of fears of communicable diseases (23%), a lack of knowledge of these products (88%) as well as the strong odor associated with goat products (67%) in the Alibori department. Future development programs for the milk sector in Benin should therefore integrate and implement initiatives aimed at generating interest among the population in the consumption of milk from small ruminants, which will create demand for its products on the market and thus boost its production in livestock farms..

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INTRODUCTION

Milk and dairy products occupy a significant place in human nutrition given its richness in nutrients and its undeniable health benefits (Jeong *et al.*, 2024; Nandan and Kumar, 2022). It is estimated that more than 6 billion consumers spread across all territories of the globe have been identified while nearly 150 million households are engaged in the production sector (Kapaj and Deci, 2017). In order to ensure a continuous supply of dairy products, the most requested animal species remains mainly the bovine species, but several other species are exploited depending on the communities and regions and as such, small ruminants represented by sheep and goats occupy a prominent place (Faccia *et al.*, 2020; Fox *et al.*, 2015). Indeed, sheep and goat dairy products play an important role in agriculture and food in many regions, particularly due to their nutritional value and processing potential (Bencini and Pulina, 1997; Nayik *et al.*, 2022). In Benin, despite development programs initiated several decades ago to ensure food self-sufficiency in the sector, national milk production still remains below national demand (Aniˆhouvi ˙ *et al.*, 2019; Yassegoungbe *et al.*, 2022). This forces the country to rely heavily on imported dairy products to meet consumer needs. To address the low productivity of dairy breeds and increase the development of the "milk and dairy products" value chain, the Beninese government has implemented several initiatives such as artificial insemination of local breeds using semen from high-yielding dairy breeds, while efforts are underway to improve animal nutrition by promoting fodder production farms and the use of locally available food resources, such as crop residues (Adamou *et al.*, 2024; Adédigba *et al.*, 2023; Icoutchika *et al.*, 2022). In addition, various projects are being implemented to revitalize the local dairy sector by structuring the various stakeholders in the sector. Most of these initiatives are oriented towards dairy cow farming, but in the country, an increasingly large proportion of small ruminant farmers practice milking the milk from their animals; but unfortunately, the milk from sheep and goats is not valued (Dossa *et al.*, 2008; Icoutchika *et al.*, 2022). To explain this situation, several factors are generally implicated. These are mainly socio-economic determinants including the practices and perceptions of populations which vary greatly depending on the communities and geographical regions (Durmuş *et al.*, 2019; Nandan and Kumar, 2022). But also the level of information of communities regarding the benefits associated with the consumption of sheep and goat milk is generally low among populations living in rural areas (Güney and Sangün, 2019; McLean-Meyinsse and Cavalier, 2004; Nandan and Kumar, 2022). In this context, it is essential to understand the perceptions of farmers, processors, traders and consumers regarding sheep and goat dairy products, in order to identify obstacles to milk collection and processing, assess consumer expectations and propose solutions to encourage better milk valorization. By highlighting the perceptions of the different actors in the value chain, the objective is to promote a more sustainable and economically viable exploitation of these resources, thus contributing to food security and improving the economic conditions of stakeholders. It is with this in mind that this study is conducted.

MATERIALS AND METHODS

Study area

This study was conducted in West Africa in Benin and concerned several communities across the twelve departments of the country. These departments include, from North to South: Alibori, Borgou, Atacora, Donga, Collines (Hill), Zou, Couffo, Mono, Plateau, Oueme, Atlantique, Littoral (Coastline). The map showing the geographical location of the country is presented in Fig. 1.

Sampling and data collection

A cross-sectional survey was conducted in twelve targeted departments in order to study the perceptions of the different actors involved in the value chain "milk and dairy products in Benin". To this end, a questionnaire was developed and then administered to breeders, consumers, processors and traders of small ruminant milk in the twelve

departments using the snowball method. A total of 1198 actors associated with the value chain "milk and dairy products" distributed as follows were interviewed. These are: 288 small ruminant breeders, 150 dairy product processors, 125 dairy product traders, and 507 consumers. The survey form was digitized on the Kobotoolbox platform and then administered to the different actors identified, while each actor was enrolled in the study on the basis of informed consent.

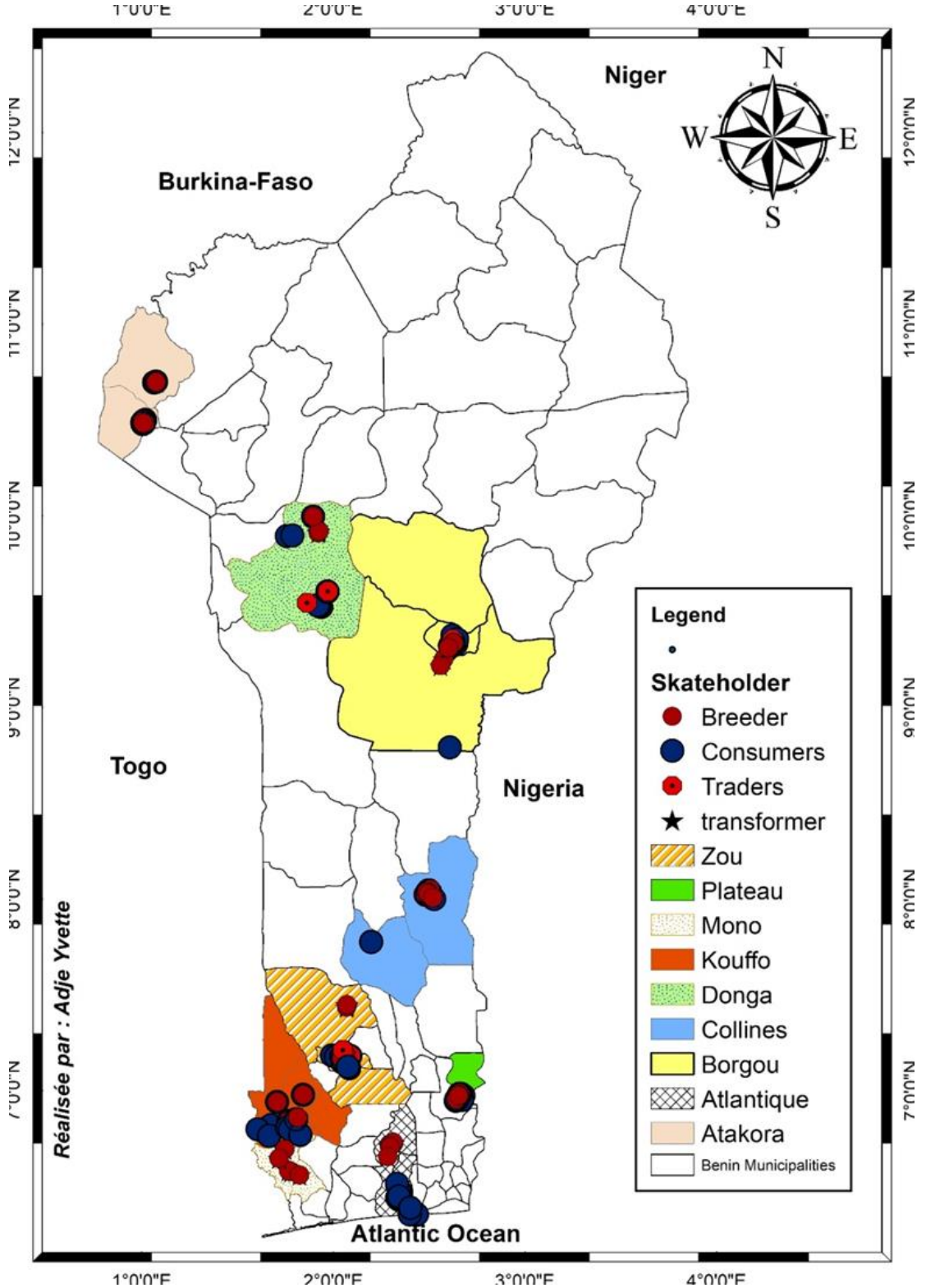

Fig. 1. Map of Benin showing the departments studied

Statistical analysis

The collected data was exported to a Microsoft Excel workbook and then Statistical analyses were carried out using R Software 4.0.5. For this purpose, descriptive analyses were carried out to calculate the proportions of the modalities of the different variables associated with the socio-demographic characteristics as well as the perception of the actors surveyed.

Subsequently, the chi- square test was summer used for the comparison of the proportions of the modalities of the different variables according to the departments. For all comparisons, the p-value values used were set at a threshold of 5 %. For the multiple correspondence analysis (MCA), the MCA function from the FactoMineR package in R was applied (Husson *et al.*, 2017; Cornillon *et al.*, 2018) on a contingency table mapping individuals as rows and variables as columns.

RESULTS

Sociodemographic characteristics of the stakeholders

The breeders

The sociodemographic characteristics of the group of breeders studied are summarized in Table 1.

Table 1. Sociodemographic characteristics of breeders

Variables	Number of employees n (%) N = 288
Age	
25-35 years old	127 (44%)
< 25 years old	8 (2.8%)
>35 years old	153 (53%)
Sex	
Female	85 (30%)
Male	203 (70%)
Education	
None	158 (55%)
Primary	72 (25%)
Secondary	51 (18%)
Superior	7 (2.4%)
Sector of activity	
Artisan	21 (7.4%)
Merchant	50 (18%)
Animal production	155 (54%)
Official	5 (1.8%)
Plant production	54 (19%)
Professional experience	
5 - 10 years	146 (51%)
< 5 years	27 (9.4%)
>10 years	115 (40%)

A total of 288 small ruminant breeders from different departments were interviewed. Breeders aged over 35 years constituted more than half of the respondents (53%).

Table 2. Sociodemographic characteristics of processors

Variables	Number of employees n (%) N = 150
Department	
Alibori	17 (11%)
Atacora	15 (10%)
Borgou	17 (11%)
Collines	15 (10%)
Couffo	15 (10%)
Donga	15 (10%)
Plateau	37 (25%)
Zou	18 (12%)
Sex	
Female	125 (87%)
Male	19 (13%)
Age	
18–29 years old	19 (13%)
30–39 years old	60 (42%)
40–49 years old	46 (32%)
50–59 years old	15 (10%)
60 years and over	4 (2.8%)
Education	
University	09 (6.2 %)
None	71 (48%)
Primary	41 (28%)
Secondary	26 (18%)
Occupation	
Unemployed	8 (5.4%)
Employee	18 (12%)
Student	4 (2.7%)
Housewife	113 (77%)
Retirement	4 (2.7%)
Experience in transformation	
1 to 3 years	35 (28%)
4 to 7 years old	33 (26%)
Less than 1 year	3 (2.4%)
Over 7 years old	54 (43%)
What type of milk do you process?	
Sheep and goats	1 (0.8%)
Cow's milk	126 (99%)

Approximately 70% of the respondents were men versus 30% women. The level of education was somewhat low since more than half of them (55%) had received no school education, while nearly 25% had a level of education corresponding to primary education. In addition, 54 % of the breeders carried out animal production as their main activity and also exploited other animal species apart from small ruminants. On the other hand, the majorities

of breeders (91%) were rather experienced and had been breeding small ruminants for at least 5 years.

The milk processors

A total of 150 actors involved in the field of dairy processing were interviewed. The majority were women (87%) versus a minority of male actors (13%). A significant proportion had received no formal education (48%) while a significant proportion were housewives (77%) and had no other income-generating activities apart from dairy processing. Furthermore, 47% of respondents have at least 7 years of experience in the processing field and apart from a single actor (01/150) who processes sheep and goat milk, 99% of them mainly process cow's milk (Table 2).

Table 3. Sociodemographic characteristics of traders

Variables	Number of employees n (%) with N = 125
Department	
Alibori	16 (13%)
Atacora	15 (12%)
Borgou	16 (13%)
Collines	14 (11%)
Couffo	17 (14%)
Donga	15 (12%)
Mono	1 (0.8%)
Plateau	15 (12%)
Zou	16 (13%)
Sex	
Female	109 (92%)
Male	9 (7.6%)
Age	
18–29 years old	19 (16%)
30–39 years old	62 (52%)
40–49 years old	32 (27%)
50–59 years old	6 (5.0%)
60 years and over	1 (0.8%)
Education	
Doctorate	1 (0.9%)
Primary	39 (34%)
License	2 (1.7%)
None	50 (43%)
Secondary	23 (20%)
Occupation	
Unemployed	8 (7.0%)
Employee	11 (9.6%)
Housewife	81 (70%)
None	15 (13%)
Eexperience	
1 to 5 years	53 (43%)
6 to 10 years old	38 (31%)
Less than 1 year	9 (7.3%)
More than 10 years	23 (19%)

The traders

The group of traders studied is made up mostly of women (92%), as are the dairy processors. The majorities of them were aged between 30 and 39 years (52%) and were housewives (70%). The dairy marketing activity has been practiced for 1 to 5 years by 43% of the respondents, while the level of education in this group was very low. About 43% had received no formal education; while 34% had a primary education level (Table 3).

Table 4. Sociodemographic characteristics of consumers

Variables	Number of employees n (%) with N = 507
Department	
Alibori	49 (9.7%)
Atacora	52 (10%)
Atlantic	48 (9.5%)
Borgou	56 (11%)
Collines	59 (12%)
Couffo	53 (10%)
Donga	56 (11%)
Littoral	19 (3.7%)
Mono	1 (0.2%)
Plateau	51 (10%)
Zou	56 (11%)
Sex	
Female	227 (45%)
Male	258 (51%)
Age	
18–29 years old	110 (22%)
30–39 years old	201 (40%)
40–49 years old	140 (28%)
50–59 years old	35 (6.9%)
60 years and over	8 (1.6%)
Education	
None	118 (23%)
Primary	133 (26%)
Secondary	175 (35%)
University	79 (16%)
Occupation	
Unemployed	49 (9.7%)
Shopkeeper	187 (37%)
Student	20 (3.9%)
Official	174 (34%)
Housewife	74 (15%)
Medium	
Urban	280 (55%)
Rural	222 (44%)
Milk consumption	
No	38 (7.5%)
Yes	468 (92%)

Consumers

A total of 507 dairy consumers from eleven departments were interviewed. Approximately 51% of respondents

were men versus 45% women. A significant proportion of these were aged between 30 and 39 years (40%). The level of education was higher compared to other groups and 51% of respondents in this group had received at least secondary education. In addition, this group is mainly made up of female traders (37%), followed by civil servants (34%) and almost half of these, approximately 55%, resided in urban areas (Table 4).

Table 5. Breeders' perceptions regarding milking of small ruminants

Variables	Overall N = 288	Goats N = 87	Sheep N = 104	PPR N = 97	*p* -value
Do you milk sheep and goats ?					<0.001
No	246 (85%)	83 (95%)	96 (92%)	67 (69%)	
Yes	36 (13%)	3 (3.4%)	7 (6.7%)	26 (27%)	
Sometimes	6 (2.1%)	1 (1.1%)	1 (1.0%)	4 (4.1%)	
If so, why ?					<0.001
For household consumption	32 (11%)	2 (2.3%)	5 (4.9%)	25 (26%)	
Is hygiene ensured during milking ?					<0.001
No, hygiene practices are limited.	2 (0.7%)	1 (1.1%)	1 (1.0%)	0 (0%)	
Yes, I follow strict hygiene practices.	34 (12%)	2 (2.3%)	6 (5.8%)	26 (27%)	
Do you consume raw milk?					<0.001
No	246 (85%)	83 (95%)	95 (91%)	68 (70%)	
Yes	35 (12%)	3 (3.4%)	6 (5.8%)	26 (27%)	
Sometimes	7 (2.4%)	1 (1.1%)	3 (2.9%)	3 (3.1%)	
Do you consume the milk after processing?					<0.001
No, the milk is evacuated or not consumed after treatment.	1 (0.3%)	0 (0%)	0 (0%)	1 (1.0%)	
Yes, the milk is consumed after treatment.	33 (11%)	2 (2.3%)	6 (5.8%)	25 (26%)	
Transform you sheep and goat milk ?					0.014
No	277 (96%)	86 (99%)	102 (98%)	89 (92%)	
Yes	8 (2.8%)	0 (0%)	1 (1.0%)	7 (7.2%)	

For the p-value, Fisher's exact test and Pearson's Chi-squared test are performed.

PPR=Mixed Goat and Sheep

Perception of the actors surveyed

The breeders

Of the 288 farmers surveyed, only 13% (36) of them milk their animals. This includes 27% of farmers practicing mixed sheep/goat farming, 3.4% of goat farmers and 6.7% of sheep farmers. The majority of farmers who exploit milk, i.e. 32 out of 36 (88.8%), do so mainly for local consumption. Furthermore, 94.4% (34/36) of milk producers admit to respecting strict hygiene practices during milking; while 12% of farmers who carry out milking are in the habit of consuming raw milk which can be dangerous to their health. Finally, only 2.8% of the people surveyed are involved in the processing of milk from small ruminants (Table 5).

The processors

Milk processors in this study include all those involved in milk processing, regardless of the producing animal. All respondents are cow's milk processors and have so far only processed cow's milk, with the exception of 6.25% who also process small ruminant milk into cheese in the Couffo region. Between 20 and 100% of respondents said they were willing to process sheep or goat milk . However, most processors in the Borgou, Donga and Zou departments were not willing to process small ruminant milk. Among those willing to do so, the majority planned to produce traditional and mature cheeses, yogurt, butter and creams (Table 6). The main challenges identified in milk processing are the lack of appropriate equipment, lack of training or knowledge, difficulties in milk supply, and milk quality issues. Processors perceive a low demand for sheep and goat dairy products in their region, unlike producers in Collines, who consider the demand for these products moderate. Almost all processors in the departments of Alibori, Atacora, Collines, and Couffo express interest in participating in projects or programs aimed at developing sheep and goat milk processing. In contrast, more than half of respondents in the other departments are not in favor of participating in such programs.The main reason cited by the latter is that these animal species are not suited to milk production or milk processing.

Table 6. Processors' perceptions of milk and dairy products from small ruminants

Variable	Department								Chi-Square
	Alibori	Atacora	Borgou	Collines	Couffo	Donga	Plateau	Zou	
	%	%	%	%	%	%	%	%	
What types of milk do you currently process?									
Cow's milk	100	100	100	100	100	100	100	100	NS
Are you currently processing sheep or goat milk?									
No	100	100	100	100	93.75	100	100	100	NS
Yes	0	0	0	0	6.25	0	0	0	NS
If not, would you be willing to process sheep or goat milk?									
No	0	26.67	82.35	0	0	60	72.73	33.33	***
Yes	50	20	0	100	56.25	0	24.24	0	***
Maybe	50	53.33	17.65	0	43.75	40	3.03	66.67	***
What types of sheep or goat milk products would you be interested in making?									
Fresh cheeses	100	100	0	50	100	0	100	0	***
Mature cheeses	35.29	50	0	71.43	50	0	33.33	0	*
Yogurts	100	25	0	50	87.5	0	22.22	0	***
Butter	29.41	12.5	0	57.14	18.75	0	33.33	0	*
Creams	5.88	0	0	14.29	37.5	0	22.22	0	*
Others	35.29	25	0	0	0	0	0	0	**
Have you received training in dairy processing?									
No	87.5	80	100	93.33	81.25	53.33	62.5	77.78	*
Yes	12.5	20	0	6.67	18.75	46.67	37.5	22.22	*
What are the main challenges you face in dairy processing?									
Lack of appropriate equipment	100	92.86	58.82	80	93.75	100	85.71	88.24	**
Lack of training or knowledge	88.24	57.14	11.76	66.67	81.25	66.67	21.43	29.41	***
Milk supply difficulties	29.41	71.43	94.12	60	81.25	26.67	100	0	***
Milk quality problems	52.94	35.71	82.35	26.67	37.5	93.33	7.14	58.82	***
Access to markets	35.29	35.71	35.29	0	6.25	13.33	85.71	100	***
Other	0	7.14	23.53	0	0	0	0	52.94	***
How do you perceive the demand for sheep and goat dairy products in your region?									
Average	0	7.69	0	46.67	0	0	0	0	***
Very weak	64.71	92.31	93.75	0	75	100	64.71	38.89	***
Weak	35.29	0	6.25	53.33	25	0	35.29	61.11	***
Would you be interested in participating in projects or programs to develop the processing of sheep and goat dairy products?									
No	0	13.33	68.75	0	0	53.33	65.63	55.56	***
Yes	100	86.67	31.25	100	100	46.67	34.38	44.44	***
What types of support or resources would you like to see available to improve your dairy processing operations?									
Work equipment and materials	52.94	0	85.71	100	.	100	.	90	***
Financial support	58.82	0	0	0	.	0	.	90	***

*** means significant with $p < 0.001$; ** means significant with $p < 0.01$; * means significant with $p < 0.05$; NS: not significant ; %, Chi² tests were performed for variables from both department in the same line.

The traders

The milk traders in this study are mostly traders of dairy products from cow's milk except those of Mono and Couffo who rather market dairy products from small ruminants produced by the actors of the processing sector present in the region (Table 6) . The main reasons for not marketing milk from small ruminants are the lack of demand by customers, the non-existence of milk suppliers, the lack of knowledge about these products, the preferences of consumers for dairy products from cow's milk and the very high cost of milk for some. The vast majority of traders in Collines and Couffo are ready to sell dairy products from small ruminant milk unlike the other departments where there is less enthusiasm among actors to sell goat and sheep dairy products. Among those who are ready to engage in it, the majority plan to produce traditional and mature cheeses, yogurt, butter and creams (Table 7). 69% and 94% of respondents from Alibori and Couffo respectively believe that there would be customers for dairy products made from small

ruminant milk. In other areas, however, few customers for ruminant dairy products exist. Unlike those from other departments, respondents from the departments of Alibori, Atacora, Collines, Couffo and Mono are almost all (80 to 100%) interested in receiving training or information on the management, sale and promotion of sheep and goat milk. The vast majority of traders express their interest in participating in projects or programs aimed at developing the processing of sheep and goat milk.

The consumers

The majority of respondents (67.31% to 100%) consume dairy products made from cow's milk. However, in the departments of Couffo, Zou, and Atlantique, a few prefer dairy products from small ruminants. In the Plateau, 2.08% of respondents consume sheep's milk.

Table 7. Traders perceptions of milk and dairy products from small ruminants

Variable	Department									Chi²
	Alibori	Atacora	Borgou	Collines	Couffo	Donga	Mono	Plateau	Zou	
	%	%	%	%	%	%	%	%	%	
Would you be willing to sell sheep or goat milk if you had interested customers?										
No	6.25	20	62.5	0	0	46.67	0	60	18.75	***
Yes	75	33.33	12.5	78.57	82.35	33.33	0	26.67	43.75	
Maybe	18.75	46.67	25	21.43	17.65	20	100	13.33	37.5	
What types of sheep and goat milk products would you be interested in selling?										
Raw milk	81.25	58.33	0	35.71	58.82	85.71	0	0	46.15	**
Fresh cheeses	93.75	100	100	78.57	100	100	100	100	100	NS
Mature cheeses	18.75	50	50	64.29	64.71	42.86	0	0	69.23	*
Yogurts	93.75	8.33	16.67	42.86	70.59	14.29	100	0	92.31	***
Butter	6.25	0	0	64.29	17.65	57.14	100	0	0	***
Do you think there would be a demand for these products among your customers?										
No	0	8.33	53.33	0	0	46.67	0	13.33	18.75	***
Yes	68.75	33.33	0	0	94.12	0	0	26.67	6.25	
Would you be interested in receiving training or information on the management, sale and promotion of sheep and goat milk?										
No	6.25	20	81.25	0	0	60	0	53.33	37.5	***
Yes	93.75	80	18.75	100	100	40	100	46.67	62.5	
Others	0	50	0	0	0	0	0	0	20	***
Would you be interested in collaborating to promote and sell these dairy products?										
No	6.25	20	62.5	0	0	60	0	46.67	25	***
Yes	87.5	46.67	18.75	100	100	13.33	100	40	50	
Maybe	6.25	33.33	18.75	0	0	26.67	0	13.33	25	

*** means significant with $p < 0.001$; NS: not significant ; %, Chi² tests were performed for variables from both department in the same line.

Compared to cow's milk and small ruminant dairy products, the majority of consumers prefer cow's milk. However, in the departments of Zou, Couffo, and Plateau, some choose small ruminant milk. For their supplies, consumers mainly turn to supermarkets, local markets, local farms, online suppliers, or even when traveling in rural areas. The search for essential nutrients is the main motivation behind the consumption of these products. However, many consumers explain their reluctance to consume dairy products from small ruminants for various reasons: fears of diseases transmissible to humans through the consumption of these products, a lack of knowledge about them, food allergies, limited availability on the market, as well as the resulting strong flavor and odor. These products are often perceived as unhealthy due to their pronounced odor and flavor, and some consider them too traditional and not tasty. According to several respondents, these dairy products are an integral part of the Mediterranean diet and come mainly from local livestock. Information about these products is mainly obtained by consumers via social networks and television. In several regions, such as Zou, Mono, Littoral, Atlantique, Collines and Couffo, a majority of respondents say they are willing to pay for goat and sheep dairy products, despite the obstacles mentioned.

Table 8. Consumer perceptions of dairy products

Variable	Department											Chi²
	Alibori	Atacora	Atlantic	Borgou	Hill	Couffo	Donga	Coastline	Mono	Plateau	Zou	
	%	%	%	%	%	%	%	%	%	%	%	
Reason why you don't eat goat or sheep dairy products												
I don't know them	88.37	55.32	46.81	13.21	72.34	73.08	16.36	60	100	54.17	88.46	***
Lactose intolerance	2.33	0	0	16.98	48.94	11.54	36.36	0	0	0	19.23	***
Allergy	9.3	40.43	34.04	66.04	68.09	65.38	32.73	30	100	29.17	15.38	***
Transmission of animal diseases to humans	23.26	23.4	2.13	75.47	21.28	76.92	80	0	100	6.25	3.85	***
Limited availability in the domestic market	37.21	2.13	97.87	15.09	29.79	53.85	9.09	100	100	6.25	69.23	***
Cost	0	0	89.36	16.98	12.77	19.23	0	80	0	2.08	23.08	***
Strong flavor and odor	67.44	87.23	42.55	81.13	8.51	26.92	83.64	70	0	4.17	7.69	***
What concepts do you associate with goat and sheep dairy products?												
Healthy	6.12	4.17	91.67	1.96	37.04	83.02	0	70	100	8	38.46	***
Unsanitary	57.14	83.33	0	84.31	64.81	24.53	51.79	0	100	36	3.85	***
Tasty	0	0	0	1.96	55.56	39.62	0	0	0	4	44.23	***
Traditional	77.55	16.67	89.58	49.02	55.56	75.47	91.07	80	100	28	32.69	***
Strong flavor and odor	75.51	29.17	2.08	52.94	40.74	9.43	89.29	20	0	12	15.38	***
Expensive	0	0	16.67	31.37	5.56	11.32	0	40	0	8	55.77	***
Other	40.82	20.83	12.5	56.86	1.85	0	8.93	20	0	18	25	***
What characteristics do you associate with goat and sheep dairy products?												
Mediterranean diet	63.27	0	93.75	3.03	26.79	3.77	50.91	90	0	22	39.22	***
Gourmet products	4.08	0	43.75	12.12	50	1.89	40	50	0	10	60.78	***
Tasty	0	16.67	12.5	3.03	50	41.51	0	5	0	8	45.1	***
Other	61.22	50	29.17	90.91	1.79	0	36.36	35	0	40	21.57	***
What alternatives would you be willing to pay more for than goat and sheep dairy products?												
Functional product (nutritional benefits)	18.37	0	95.83	7.69	67.86	24.53	63.64	95	0	4.35	43.33	***
Other	81.63	25	25	84.62	0	1.89	0	25	0	36.96	13.33	***
How do you perceive the health of goat or sheep dairy products?												
Unsanitary	16.33	20.83	0	23.21	0	0	46.43	0	0	50	0	***
Neither healthy nor unhealthy	77.55	8.33	4.35	69.64	0	15.09	41.07	20	0	32	43.75	***
Healthy	6.12	0	95.65	3.57	100	71.7	3.57	80	100	10	50	***
Very unsanitary	0	70.83	0	3.57	0	0	8.93	0	0	6	0	***
Very healthy	0	0	0	0	0	13.21	0	0	0	2	6.25	***
Why do you think goat and sheep dairy products are healthy?												
Nutritional benefits	24.49	0	97.83	33.33	22.81	96.23	0	90	100	7.69	65.63	***
Hypoallergenic	0	0	2.17	0	73.68	1.89	0	0	0	5.13	12.5	***
Natural product	22.45	0	95.65	66.67	92.98	30.19	50	80	0	33.33	56.25	***
Easy to digest	4.08	0	0	0	73.68	60.38	50	5	100	10.26	65.63	***
Remedy (e.g., for asthma)	24.49	0	84.78	33.33	12.28	16.98	0	55	0	5.13	6.25	***
Are you willing to pay for goat and sheep dairy products in Benin?												
Yes	46.94	12.5	91.67	3.57	98.31	83.02	8.93	90	100	18.37	78.57	***
No	53.06	87.5	8.33	96.43	1.69	16.98	91.07	10	0	81.63	21.43	***

*** means $p < 0.001$; %, Chi² tests were performed for variables from both department in the same line.

Typology of the group of traders and consumers

The dairy traders

The first three axes were retained for the interpretation of the results of the multiple correspondence analysis (MCA). The contribution to the total inertia of the three factorial axes was 30.05% (13.65% for the first axis, 9.32% for the second and 7.06% for the third).

Each axis describes a group of traders. The results of the factorial analysis are presented in Fig. 2. Group 1 is composed of traders from the Couffo and Mono departments. These individuals have an education

level ranging from primary to secondary school. They are willing to sell sheep or goat milk if these products are available and if their customers express interest. They also express an interest in receiving training or information on the management, sale, and promotion of these dairy products. In addition, they are open to collaborations to promote and sell goat and sheep milk.

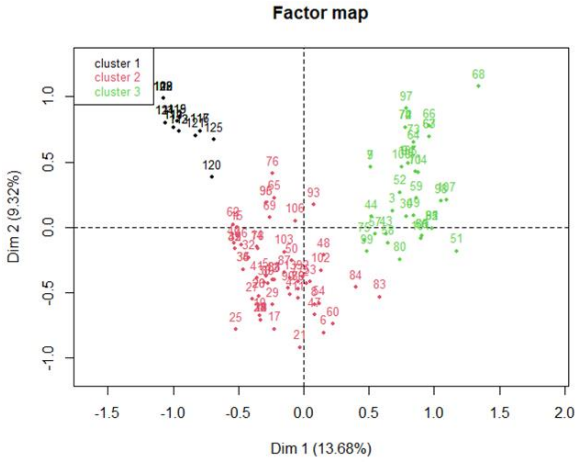

Fig. 2. Typology of dairy product traders

Group 2 consists of traders from the departments of Alibori, Atacora, Collines, Donga , Plateau, and Zou. It includes both uneducated individuals and individuals with primary or secondary education. These traders primarily process cow's milk. They do not currently sell goat or sheep milk, but are willing to do so if their customers express interest. They are also interested in training or information on the management, sale, and promotion of goat and sheep dairy products. This group is also open to collaborations aimed at promoting and selling these products.

Group 3 includes traders from the departments of Borgou, Donga, Plateau and Zou. These people, with an educational level ranging from primary to secondary, or even university, process cow's milk. Like the other groups, they do not currently sell goat or sheep milk, but are willing to do so if their customers are interested. However, unlike the previous groups, they do not express interest in receiving training or information on the management, sale and promotion of goat and sheep dairy products. Furthermore, they are not interested in collaborations to promote and sell these dairy products.

The consumers

The first four axes were retained for the interpretation of the results of the multiple correspondence analysis (MCA). The contribution to the total inertia of the four factorial axes was 31.84% (10.90% for the first axis, 8.22% for the second, 6.69% for the third and 4.43% for the fourth axis). Each axis describes a group of consumers. The results of the factorial analysis are presented in Fig. 3.

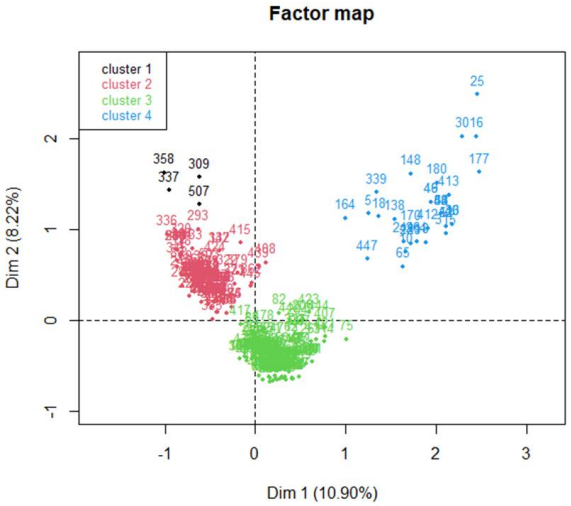

Fig. 3. Typology of dairy product consumers

Group 1 consists of people with an educational level equivalent to a master's degree. It includes agricultural sector employees as well as retirees. These individuals did not grow up in the countryside, but are nevertheless familiar with livestock farming. They consume dairy products, which they consider very healthy. Their preference is for goat milk, and they are willing to pay for goat and sheep dairy products produced in Benin.

Group 2 consists of both educated and uneducated people. Its members engage in various activities, including trade and agricultural and non-agricultural jobs. This group also includes students and housewives. Although they are not from the countryside, these people consume dairy products that they consider healthy. They prefer cow's milk

and are unwilling to pay for goat or sheep milk products produced in Benin.

Group 3 is similar to group 2, with a mixed composition of educated and uneducated individuals. This group consists mainly of traders and housewives, as well as the unemployed and others with various occupations. Some members grew up in the countryside and are familiar with livestock farming, while others are not. These people consume dairy products, and although they consider goat and sheep milk to be neither healthy nor unhealthy, they prefer cow's milk. However, they are willing to pay for goat and sheep dairy products produced in Benin.

Group 4 is made up of educated and uneducated people. It includes housewives and employees working in sectors other than agriculture. Some grew up in the countryside and are familiar with animal husbandry, while others are not. This group does not consume dairy products and finds goat and sheep milk particularly unhealthy.

Table 9. Association between sociodemographic variables and milk consumption

Socio-demographic characteristics					
Variables	Consumption of small ruminant milk		Bivariate model		
	NO	YES	OR	95% CI	*p* -value
	N = 418	N = 50			
Region					
North	180 (44%)	6 (12%)	—	—	
Center	47 (11%)	6 (12%)	3.83	1.15, 12.8	0.025
South	185 (45%)	38 (76%)	6.16	2.73, 16.5	<0.00 1
Sex					
Female	186 (47%)	23 (49%)	—	—	
Male	213 (53%)	24 (51%)	0.91	0.50, 1.68	0.8
Age					
18–29 years old	98 (24%)	4 (8.0%)	—	—	
30–39 years old	177 (43%)	13 (26%)	1.80	0.62, 6.52	0.3
40–49 years old	111 (27%)	18 (36%)	3.97	1.43, 14.1	0.015
50–59 years old	20 (4.9%)	11 (22%)	13.5	4.16, 52.7	<0.001
60 years and over	3 (0.7%)	4 (8.0%)	32.7	5.59, 226	<0.001
Education					
None	99 (24%)	9 (18%)	—	—	
primary	121 (29%)	2 (4.1%)	0.18	0.03, 0.73	0.032
secondary	147 (35%)	14 (29%)	1.05	0.44, 2.60	>0.9
university	50 (12%)	24 (49%)	5.28	2.35, 12.8	<0.001
Residential area					
Urban	235 (57%)	34 (69%)	—	—	
Rural	179 (43%)	15 (31%)	0.58	0.30, 1.08	0.093
Abbreviations: CI= Confidence Interval , OR= Odds Ratio					

Determinants of milk consumption among consumers

Association between sociodemographic variables and goat or sheep milk consumption

The results of the bivariate logistic regression performed demonstrate that there is no association between sex, area of residence and the consumption of small ruminant milk (p>0.05). On the other hand, the area of residence, age and level of education were predictors of the consumption of sheep and goat milk. Thus, consumers in the South are six times more likely to consume sheep and goat milk products than those in the North (OR=6.16; p<0.001) (Table 9).

Furthermore, people over 40 years old consume these products the most, compared to younger people (p<0.015); while people with a university education consume 5.28 times more small ruminant milk than those with no education (OR=5.28; p<0.001).

Associations between perception and consumption of goat or sheep milk

The existence of a potential link between consumer perception and the propensity to consume sheep and goat milk is presented in the Table 10 below. Overall, people who already consume sheep and goat milk express an interest 4.22 times higher than non-

consumers in having more information on the nutritional composition of small ruminant milk (OR= 4.22; $p < 0.001$).

Consumers who think that dairy products are healthy are 16.8 times more likely to consume them. Similarly, those who think that these products are tasty are 7.5 times more likely to consume them (OR = 7.5; $p < 0.0001$), while those who think that they are unhealthy or have a strong odor do not consume them at all ($p < 0.001$). On the other hand, those who think that small ruminant milk is expensive are 2.51 times more likely to consume it despite this constraint (OR=2.51; p=0.008). As for the perception in relation to their healthiness, those who think that these products are very healthy are 76 times more likely to consume them than those who think the opposite. Finally, respondents who already consume milk are 25 times more likely to consume more than those who do not consume it (OR=25.1; p<0.001).

Table 10. Associations between perception and consumption of milk

Consumer perception					
Variables	Consumption of sheep's milk		Bivariate model		
	No	Yes	OR	95% CI	*p* -value
	N = 418	N = 50			
Interest in knowing the nutrients in milk					
No	215 (62%)	14 (28%)	—	—	
Yes	131 (38%)	36 (72%)	4.22	2.24, 8.37	<0.001
Cause of non-consumption of milk from small ruminants					
No knowledge about its products	221 (54%)	2 (40%)	0.56	0.07, 3.40	0.5
Disease transmission	159 (39%)	1 (20%)	0.39	0.02, 2.65	0.4
Unavailability on the market	152 (37%)	4 (80%)	6.68	0.98, 131	0.091
High cost of milk from small ruminants	88 (22%)	2 (40%)	2.41	0.31, 14.8	0.3
Bad smell	194 (48%)	2 (40%)	0.73	0.10, 4.44	0.7
Concept associated with dairy products from small ruminants					
Healthy products	122 (31%)	29 (63%)	3.86	2.07, 7.42	<0.001
Unsanitary products	176 (44%)	3 (6.5%)	0.09	0.02, 0.25	<0.001
Tasty product	50 (13%)	24 (52%)	7.59	3.97, 14.6	<0.001
Too traditional product	249 (63%)	27 (59%)	0.85	0.46, 1.60	0.6
Strong odor	160 (40%)	5 (11%)	0.18	0.06, 0.43	<0.001
Expensive	59 (15%)	14 (30%)	2.51	1.23, 4.91	0.008
How do you perceive the health of goat or sheep dairy products?					
Unsanitary	76 (19%)	1 (2.0%)	—	—	
Neither healthy nor unhealthy	141 (35%)	10 (20%)	5.39	1.00, 99.9	0.11
Healthy	154 (38%)	34 (68%)	16.8	3.51, 301	0.006
Very unsanitary	29 (7.2%)	0 (0%)	0.00	-	>0.9
Very healthy	5 (1.2%)	5 (10%)	76.0	9.96, 1,618	<0.001
Are you willing to pay for goat and sheep dairy products in Benin?					
No	215 (52%)	2 (4.0%)	—	—	
Yes	200 (48%)	48 (96%)	25.8	7.86, 159	<0.001

Abbreviations: CI = Confidence Interval, OR = Odds Ratio

DISCUSSION

In Benin, the "milk and dairy products " value chain is made up of several actors, including farmers, dairy processors, traders and consumers (Dossou *et al.*, 2022; Sessou *et al.*, 2023; Komagbe *et al.*, 2023). Until now, dairy production and processing into derivative products is mainly of an artisanal and informal nature. Moreover, it is mainly based on the exploitation of cattle concentrated in the northern part of the country mainly (Anïhouvi ˙ *et al.*, 2019; Yassegoungbe *et al.*, 2022) . National production is always lower than the country's needs, which justifies the significant quantity of milk and dairy products imported each year into the country. Although the quantity of milk produced by sheep and goats is generally lower than that of cattle, the breeding of small ruminants remains less restrictive than that of large ruminants (Edoh *et al.*, 2023). The livestock of sheep and goats is distributed in all regions of the country, unlike cattle.

The promotion and valorization of milk from small ruminants in addition to that from cattle in Benin could therefore represent a solution to the deficit recorded in the country (Icoutchika *et al.*, 2022; Vissoh *et al.*, 2021) with the impact of improving the living conditions of breeders while contributing to the economic growth of the country. This study, which focused on the perceptions of the various stakeholders in the dairy sector, shows that the contribution of milk from small ruminant farming in this sector is still very marginal.

However, a significant proportion of farmers (15%), which could not be ignored, admitted to milking milk from small ruminants, but less than 1% of processors admitted to having processed milk from these animal species.

This situation is justified since the production of sheep and goat milk in Africa, although presenting significant potential, remains mainly an artisanal and subsistence activity, with notable challenges in terms of productivity and structuring of the value chain (Idamokoro *et al.*, 2019; Kahi and Wasike, 2019). Indeed, small ruminant farming in Africa is traditionally oriented towards meat production, with milk production often being secondary and intended for self-consumption by the farmer's family or lambs (Kahi and Wasike , 2019) . In addition, local breeds, such as the Sahel goat or the Maradi Red in Benin, have a low or very modest average milk production, which negatively impacts the profitability of small ruminant dairy farms (Icoutchika *et al.*, 2022; Vissoh *et al.*, 2021) . Furthermore, studies carried out by Vissoh *et al.* (2021) in Benin showed dairy performances of locally raised alpine goats which, although better than those of local breeds, remain below those of the same breeds in temperate environments, which represents an additional constraint for development projects based on the exploitation of exotic breeds. Less than 1% of processors admitted to having processed milk from small ruminants. This observation is justified since the marketing and processing of sheep and goat milk in the main African countries, remains still a taboo even though the milk from these animals is considered more nutritious than cow's milk and better tolerated by some people (Degen, 2007; Idamokoro *et al.*, 2019; Lankanatha *et al.*, 2025) . It is also valued in certain regions of the world for its quality and is used to manufacture a variety of dairy products (Fox *et al.*, 2015) . Furthermore, this situation is expected to improve since 40% of breeders admitted to being ready to process milk into cheese if demand becomes strong, while 20 to 100% of processors surveyed say they are ready to process sheep or goat milk depending on the department. The perception of breeders and processors regarding small ruminant milk and its derivatives is rather interesting as reported by Icoutchika *et al.* (2022) in a study carried out in agricultural households in northern Benin where milk from this species enjoys a good reputation. As for the traders, the majority are interested in marketing milk and milk-derived products if the customers, i.e. consumers, are available, while a very significant proportion is willing to participate in projects or programs aimed at developing the processing of sheep and goat milk. This high level of adherence is certainly linked to the interest that can arise from it since the sale of these products could constitute an additional source of income.

Finally, most consumers are reluctant to consume dairy products from small ruminants due to various factors, such as the fear of diseases transmissible to humans through the consumption of these products, the lack of knowledge of these products as well as their limited availability on the market. This situation is also explained by the prejudices attached to small ruminants, in particular the strong smell of their meat. In addition, the survey showed that the small proportion of those who consume these products have adopted them given the Mediterranean diet that they practice intermittently. The reluctance of certain communities towards the milk of small ruminants has already been reported by some authors in the Sahel where some agro-pastoral communities in Mali and Senegal perceived goat's milk as a source of asymptomatic diseases and excluded it from their diet while others adopted it (Hetzel *et al.*, 2005; Missohou *et al.*, 2004; Traoré *et al.*, 2018).

The results of our research indicate that a proportion of consumers had a poor perception of small ruminant dairy products due to a lack of knowledge of their benefits and it is certain that once informed of the benefits of these, consumers could adopt these foods in a more significant way.

Future development programs for the milk sector in Benin should therefore include initiatives aimed at generating interest among populations in the consumption of milk from small ruminants, which will create demand for its products on the market and thus boost its production in livestock farms. In addition, raising awareness among communities about the benefits of consuming these products should be prioritized in order to create a better image of these products among consumers.

CONCLUSION

This study assessed the perceptions of actors in the "milk and dairy products" value chain in Benin regarding small ruminant milk and its derivatives. The results demonstrate that the various actors apart from consumers had a good perception of small ruminant milk. The latter are ready to produce process and market its products. However, consumers are reluctant to adopt small ruminant milk and its derivatives in their diet. This situation is linked to several factors including the lack of knowledge of the health benefits of its products. In order to contribute to the improvement of the living conditions of agricultural households that practice this activity and promote its development, we recommend that communication programs be initiated in the communities to inform households about the consumption of goat's milk and its health benefits and thus encourage its adoption.

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