Somali consumers' camel meat consumption satisfactions under climate change[1]

Yavuz Topcu*, Hassan Ahmed Elmi**

DOI: 10.30682/nm2304l
JEL codes: Q13, Q54

Abstract

Global climate change has rapidly changed consumers'attitude and behavior toward food products by affecting significantly their supply and demand. In this context, it was planned to determine the main factors affecting camel meat consumption satisfaction of Somalia consumers under the climate change conditions. The maim material of the research was obtained from 385 households residing in Mogadishu, Somalia in 2022. Exploratory Factor Analysis and Two-step Cluster Analysis were used to explore Somalia consumers' camel meat consumption satisfaction. The results of the study highlighted that the low and middle-income consumers focused on healthy diet willingness under the hedonic quality attributes mitigating the ecological footprint in livestock on their camel meat consumption satisfaction. On the other hand, it was also analyzed that the high-income segment yielded more importance to their sensory and real quality attributes through the animal care and feeding management strategies adapted to climate change. Therefore, it should be given the priorty to local production and marketing strategies that mitigate the impacts of ecological footprints and adapt farm and natural resources management to climate change for sustainable consumption satisfaction in livestock products.

Keywords*: Exploratory Factor Analysis, Camel meat consumption, Climate change, Consumer satisfaction.*

1. Introduction

Food supply chain due to increasing high population rate has dramatically led to the negative effects on the global climate ecosystem in the last years. Total amount of red meat consumption in the world, indeed, has constantly continued to increase as a result of positive socioeconomic, psychological and individual motivation factors (Sanchez-Sabate and Sabaté, 2019; Godfray *et al.*, 2018; Graham and Abrahamse, 2017). Increasing consumption trends on global food supply system have caused to vital threats including in climate change and environmental degradation.

On the other hand, consumers' red meat consumption providing a significant impact on human diets and healthy nutrition in developed countries have remained to increase in the last years (Figures 1 and 2), and rising middle-income consumers' meat demands in developing countries have also depicted a positive trend (OECD/FAO, 2021; Graham and Abrahamse, 2017; Gerber *et al.*, 2013).

Similarly, consumers' increasing welfare levels and the expanding food supply chain under the

[1] The manuscript was derived from the MS thesis.

* Ataturk University, College of Agriculture, Department of Agricultural Economics, Erzurum, Türkiye.
** Ataturk University, Graduate School Natural and Applied Science, Department of Agricultural Economics, Erzurum, Türkiye.
Corresponding author: yavuztopcu@atauni.edu.tr

Figure 1 - World red meat consumption trends per capita (kg/year).

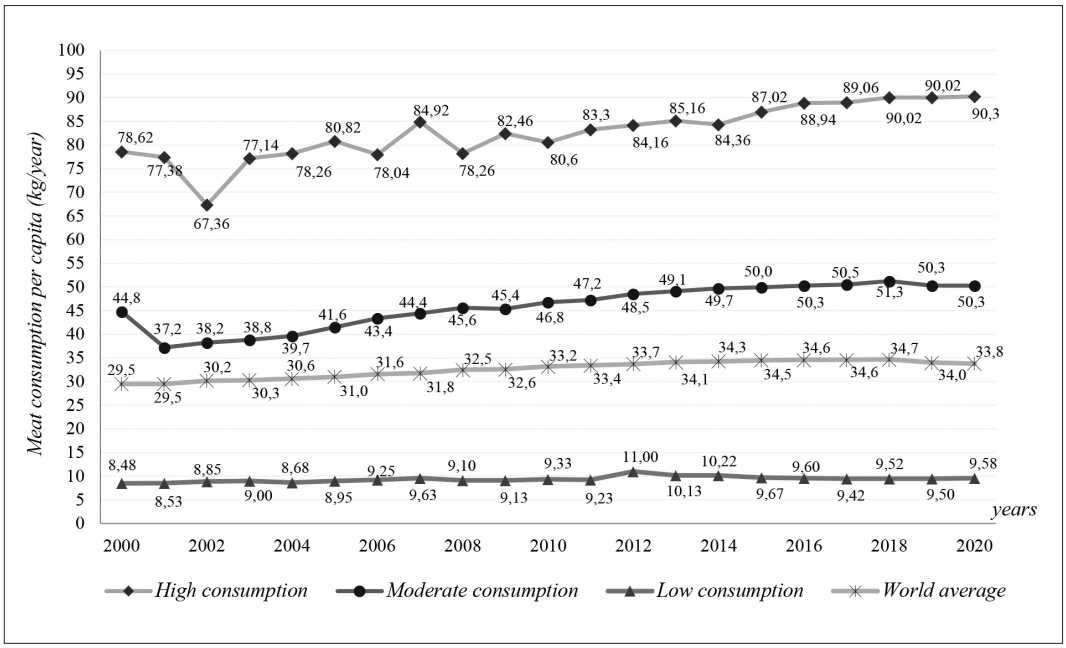
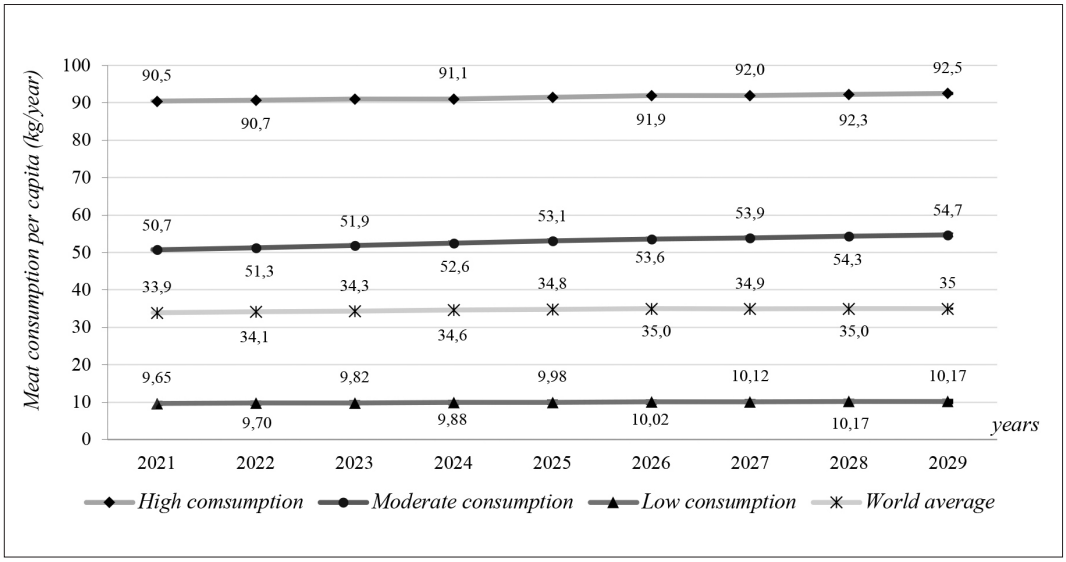


Figure 2 - World red meat consumption forecast trends per capita (kg/year).



significant supports provided to livestock sector by political and economic institutions are the important drivers of red meat consumption. These approaches have recently highlighted an opposite paradigm that point out, therefore, the interactions between dramatic pressures on environment to support red meat production and increasing consumer demands for red meat consumption.

Intensive and poorly managed livestock production and its industrial processes cause the negative impacts on climate changes through increasing ecological footprint based on stream

and groundwater resources polluted by antibiotics, hormones and chemical implications, and on biodiversity losses resulted from intensive carbon emissions (Harguess *et al.*, 2020; Sanchez-Sabate and Sabaté, 2019; Willett *et al.*, 2019; Neff *et al.*, 2018; Graham and Abrahamse, 2017). Livestock also influences climate conditions through land use change, feed production, manure, production, processing, marketing and, furthermore, consumption of the animal products.

In other words, feed production, land use change and manure emit CO_2, N_2O (nitrous oxide), CH_4 (methane) that contribute to climate change. Similarly, animal production increases CH_4 emission, and then their processing, transport, marketing, retailing and consumption contribute to CO_2 emission raise (Godde *et al.*, 2021; Rojas-Downing *et al.*, 2017; Bellarby *et al.*, 2013; Gerber *et al.*, 2013). Actually, unsuccessfully organized and managed livestock activities and natural resources have triggered devastating degradations on further environment via climate change in last years.

On the other hand, livestock affecting negatively climate change are possible to be under the direct and indirect impacts of climate change. The direct effects on livestock become from the impacts on animal health, heat stress, welfare, growth, reproduction, breeds, herd variety and size, and livestock system; whereas the indirect impacts are strictly linked with the productivity of pastures, quality and quantity of feed, biodiverse loss, competition for natural resources, water availability, precipitation variation, extreme climate events, economic cost of inputs, food supply and security (Godde *et al.*, 2021; Wreford and Topp, 2020; Rojas-Downing *et al.*, 2017; FAO, 2013; Polley *et al.*, 2013; Henry *et al.*, 2012).

As a result of the interactions between livestock production and climate change; the availability of animal products, their nutritional value, quality and safety could decrease, and then consumers' consumption preferences and purchasing patterns could considerably alter in view of sensory and hedonic quality attributes along animal food supply chain. Additionally, food cost, price and price volatility along food supply chain could dramatically increase, and thus changing national social norms could impact significantly their diets, especially in high-income communities.

Climate change is fundamentally evaluated, therefore, as a major concern and threat source for current livestock systems and animal products' consumption worldwide (Godde *at al.*, 2021). It was recommended that not only was not enough to adapt the livestock system to climate change, but it was also necessary to mitigate consumers' red meat consumption and to alter essentially their consumption patterns based on changes in their consumption attitudes (Graham and Ambrahamse, 2017).

In the context, the dietary guidelines in developed countries explain how shift to more plant-based mixed-type from less meat-based diets, and thus the instructions could be accepted as a viable strategy to mitigate environmental issues and climate change. Efforts to increase insufficient red meat consumption in developing countries, however, also arises to a strategic contradiction about protection of the natural resources related to climate and environmental factors. In light of these progresses, although it is easier to implement technological and economic strategies to reduce the negative effects of red meat production on climate change and environment, trying to change consumer attitudes towards red meat consumption makes a more complex and difficult process necessary (Sabate and Sabate, 2019). According to a report published by FAO in 2013, indeed, it was stated that main reason of consumers' animal product demand increase in the early 2000s resulted from a change in communities' diet choices with various campaigns (Graham and Ambrahamse, 2017).

Particularly, it was reported that consumers' psychological factors towards their food preference and satisfaction had a much greater impact than their socioeconomic ones such as gender, age, education, profession on their attitudes and behaviors patterns (Harguess *et al.*, 2020; Graham and Ambrahamse, 2017; Kleemann and Schmidt, 2017). Hence, consumers' personal factors (attitude and value, knowledge and skill, emotion and cognitive level, taste, demographic factors), their sociocultural attributes (culture and belief, social norm and status), and the external factors (political and economic factors related to food marketing environ-

ments) should be assessed for their food purchase patterns so that it could be mitigated major impacts of climate change caused by red meat consumption (Harguess *et al.*, 2020; Topcu *et al.*, 2015).

In research region, Somalia, livestock system has been affecting significantly from especially drought, lacks of water resources and grasslands, feed shortage and sudden weather events resulted from climate change in the last decade years. Camels being able to resist water shortage and drought for a long time unlike the herds of cattle, sheep and goats are spread to all rural areas of the country, and also play an important role on rural economy in Somalia. Camel breeding meeting about 21% of camel population, 10% of camel meat and 30% of camel milk in the world provides a big added value to countries' gross domestic product (GDP) (Ali and Çalışkan, 2019).

On the other hand, the production of camel meat is carried out generically by local butchers or retailers in unhygienic open slaughter areas. Generic camel meats sold unbranded at retailer outlets such as butchers or groceries at domestic market, therefore, are often consumed as fresh or dried meat in the long term. Camel meat are widely consumed by Somali consumers, moreover, due to its healthier and higher nutritional values than other red meats. In fact, consumers' annual red meat consumption per capita was calculated as 19 kg, and about 75% of this consumption are projected to be camel meat according to the data obtained from the field study in Mogadishu, Somalia.

However, recently, Somalia consumers' consumption preferences and satisfactions have considerably altered depending on their socioeconomic and psychological attributes on their purchase patterns so that they could mitigate adverse impacts of climate change resulted from camel meat consumption. Consumers towards camel meat consumption in Somalia, furthermore, have always preferred animal farms to the others, which livestock production system could adapt to climate change.

Therefore, it has been continuously observed a change in Somalia consumers' purchase attitude and behaviors towards camel meat consumption. Determining the factors triggering, thus, the changes in consumers' camel meat purchase attitude and behaviors could play a big role on the marketing strategies mitigating the impacts of climate change and ensuring the consumption satisfactions of consumers.

In sight of all these progresses, the aim of the study is to determine the main factors impacting on Somalia consumers' camel meat consumption preferences and satisfaction in Mogadishu under climate change. In the scientific literature, although it was met to a lot studies related to camel breeding, the carcass attributes of camel meat, and various technical matters related to camel meat production and processing, it was not accessed to any research on consumers' camel meat consumption preferences and satisfaction. With the current study, therefore, it was also assumed to be able to fill this gap in the literature of the consumption economics.

2. Literature review

The impacts of climate change on crop production and its land uses have been frequently examined by a lot of local researches worldwide, however a limited number research have been conducted on livestock production and processing of animal products under the effects of climate change (Wang and McCarl, 2021). Espacially, it was highlighted by Godde *et al.* (2021), Wreford and Topp (2020), Rojas-Downing *et al.* (2017) that climate change being a major concern for current livestock systems worldwide have adversely affected directly and indirectly feed and water resources, biodiversity, livestock health, reproduction and production, food security, as well as processing, storage, marketing, retailing and consumption of animal products in the last years.

In similar to the impacts of climate change, it was also reported that livestock system negatively contributed to climate change through land use change, feed and animal production, manure, and livestock product processing, marketing, consumption, and thus this sector was often attributed by adverse environmental effects such as land degradation, air and water pollution and biodiversity destruction (Godde *et al.*, 2021; Rojas-Downing *et al.*, 2017; Bellarby *et al.*, 2013; Gerber *et al.*, 2013).

Along with these negative progresses, it was also declared that adverse impacts of livestock production and animal product consumption on climate change could be mitigated, and provided adaptation to current changing conditions with various implementation measures (Godde *et al.*, 2021; Rojas-Downing *et al.*, 2017; Barnes *et al.*, 2013). Adaptation measures firstly consist of managerial modification on current production and consumption systems, breeding strategies, institutional and optical changes, scientific and technical advances, changing farmer and consumer perception and adaptive capacity, and plant-based mixed-type diet implementations. Mitigation measures also account for carbon sequestration, improving rations to reduce enteric fermentation, effective manure and fertilizer management, and shifting human dietary trends. Whereas measures adapted to climate change could be implemented much more easily by individual efforts, however, the implementations mitigating the impacts of climate change could be applied effectively with public policy supports.

In spite of adverse relationships between livestock system and climate change, societies' attitudes towards consumption preferences and purchase patterns of livestock products, meat and meat products, milk and milk products and eggs, are gradually altering along food supply chain with the boosting awareness of climate change (Godde *et al.*, 2021; Godfray *et al.*, 2018; Motoki *et al.*, 2018). It was explained that the most important actor at the food supply chain were accepted to be target consumers, and thus consumers' socioeconomic, psychological and individual attributes for the customer-oriented marketing strategies also played the most critical role in shaping their purchase patterns (Badar *et al.*, 2023; Burnier *et al.*, 2021; Harguess *et al.*, 2020).

In various studies related to consumers' red meat consumption preferences, it was firstly referred that the psychological factors were of a higher impact than the others on consumers' meat consumption perception and preferences. Among them, Topcu *et al.* (2015) highlighted that sensory meat quality attributes triggered the consumers' sensory perceptions, and their individual incomes and meat prices on their purchase decisions were of a more impact on the hedonism ones. It was pointed out that, on the other hand, the consumers' meat consumption was positively affected by the factors such as their marital status, occupation and income, popular meat type, sanitation and nutritional values. Topcu (2022a), similarly, reported that the sensory and hedonic quality attributes on consumers' veal consumption preferences created directly a positive effect, but the natural risk factors impacting on climate change and Covid-19 pandemic also caused indirectly a negative impact on consumer satisfaction.

Additionally, Gültekin and Soro (2020) declared that hedonic quality attributes such as price, shopping point and comfort, meat quality and brand image had a significant effect on consumers' meat purchase decisions, and these variables were often influenced by their demographic variables including easy to access to shopping points/retailer, consumption amounts and education levels. Burnier *et al.* (2021), however, focused on not only beef intrinsic attributes such as tenderness, freshness and leanness but also experience appearance and taste for consumer choices. Delgado and Flores (2015) also reported that the demographic factors affecting consumers' meat consumption amount linked with family size and income, schooling rate, read meat types with fat contents, nutritional values and chronic diseases.

Wang *et al.* (2022), Harguess *et al.* (2020), Tosun and Hatirli (2009), and Gündüz *et al.* (2006) highlighted that the sensory quality attributes such as freshness, juiciness, color, flavor and quality of red meat provided a positive motivation on consumers' consumption satisfaction; when demographic factors covering families' income, food prices, their education levels, distance to market, their purchase frequencies, market club card membership and usage affected positively their red meat consumption. Bouranta *et al.* (2022), Topcu *et al.* (2015) and Karakuş *et al.* (2008), furthermore, indicated that the most important factors for consumers when purchasing food were food quality and safety, as well as sanitary conditions along food supply chain including in the production, processing, marketing and retailing stages.

On the other hand, Mesías *et al.* (2023) and

Burnier *et al.* (2021) highlighted that sustainable food consumption under the impacts of climate change would affect the decision-making processes taking into consideration not only consumers' individual needs related to the sensory and hedonic attributes, but also their attitudes towards social responsibility consciousness such as low carbon footprint, sustainable food production techniques and consumption and sustainable labeling, diet change trends, traceability, animal welfare, fair trade, good agricultural practices and management of the livestock farms.

3. Material and methods

3.1. *Material*

The main material of the research consisted of primary data obtained from households consuming camel meat by using face-to-face and online questionnaires techniques in Mogadishu, the capital city of Somalia, in 2022. On the other hand, the secondary data was collected from various statistical institutions and organizations such as FAOSTAT, USDA, OECD and TUIK, and provided from the scientific publications including in the reports of the research projects, the review and research papers of the scientific journals.

3.2. *Methods*

3.2.1. *Method used to determine the sampling size*

In order to ensure the homogenous participation of the households consuming camel meat in Mogadishu, the city was divided into sub-regions covering east-west and north-south directions, and the sample size in Equation 1 was calculated by being used the Simple Random Sampling Method (Karagöz, 2019; Malhotra, 1993).

$$n = \frac{Z^2 \cdot p \cdot q}{c^2} = \frac{(1.96)^2 \cdot (0.5) \cdot (0.5)}{(0.05)^2} = 385$$

In Equation 1:
n: Sample size
Z: Z value (with 95% confidence interval (1.96)
p: Camel meat consumption probability (0.50)
c: Error term (0.05 = ±5)

In order to reach the targeted sample size and to eliminate erroneous questionnaires caused by both researchers and participants, the sample volume was increased in 5% rate, and thus a survey was conducted with 405 households. The erroneous, however, questionnaires were removed during data transfer, and then statistical analyses were conducted on 385 correct and complete questionnaires.

3.2.2. *Method used for preparation of questionnaire forms*

In order to design the attitude scales of the research model considering Somalia consumers' attitude and behaviors towards camel meat consumption satisfaction under climate change was utilized from the questionnaire forms applied in domestic and foreign scientific studies. The satisfaction attitude scale was firstly designed as a 35-items scale that assesses Somalia consumers' sociocultural, psychological and individual attributes impacting on their camel meat consumption preferences. To put it more clearly, the sensory and hedonic quality attributes, product and communication mixes, as well as health motivation variables covered 10 and 8, 6 and 5, and 6 items respectively.

On the other hand, the risk attitude scale was secondly derived from a 20-items scale that measures consumers' sensivity or awareness to the impacts of climate change resulted from their red meat consumption preferences, and these items were given in Table 1. It was then asked the consumers participated in the survey to mark each statement on the attitude scales with 5-point Likert Scale (1: no important, 3: neutral/undecided, 5: very important).

3.2.3. *Methods used in statistics analyses*

In the first step, Explanatory Factor Analysis (EFA) was especially used to determine the main factors reflected consumers' attitude and behaviors influencing on their camel meat consumption preferences under climate change. EFA is a multivariate statistical dimension reduction technique trying to create a small number of unrelated, but conceptually meaningful new factors by bringing together variables that are related to each other (Civelek, 2020; Bursal, 2019; Aksu *et al.*, 2017).

Table 1 - Attitude attributes related to climate change caused by consumers' red meat consumption preferences.

Attitude variables	*Abbreviation*
I want to reduce my red meat consumption to mitigate carbon emissions (CO2)	R1
I want to reduce red meat consumption to mitigate methane gas (CH4) emissions	R2
I want to reduce red meat consumption to mitigate nitrous oxide (N2O) emissions	R3
I want to change red meat dietary preferences to minimize high energy level used in animal husbandry and industry	R4
I want to consume the artificial meat to lower natural red meat consumption	R5
I want to consume fish meat versus red meat	R6
I want to consume poultry meat instead of red meat	R7
In order to diminish greenhouse gas emissions, I prefer to consume the plant-based diets instead of red meat-based diets	R8
I want to reduce red meat consumption to minimize the chemicals in animal husbandry and industry	R9
I want to reduce red meat consumption to minimize high water usage levels in animal husbandry and industry	R10
I want to reduce red meat consumption so that the animal waste and pollutants do not pollute the water resources	R11
I want to utility more effectively from the natural resources such as water and land by reducing red meat consumption	R12
I would like to contribute to more effective management of the animal wastes by reducing red meat consumption	R13
I prefer to buy red meat from the farms implementing the good agricultural practices, which supply better animal feeding and care opportunities	R14
I prefer to buy red meat from the farms where use higher quality concentrated feed for animal feeding	R15
I prefer to buy red meat from the farms applied good waste management and feeding regime at animal husbandry	R16
I do not prefer red meat production at pasture-based livestock farms in red meat consumption	R17
I prefer to consume red meat produced at disease-free farms	R18
I want to reduce negative effects on both human health and environment by reducing red meat consumption	R19
I want to contribute to animal welfare by reducing red meat consumption	R20

Hierarchical steps for the EFA were followed to test the suitability of the data, to determine the main factor number, to perform the rotation (transformation) techniques, to identify main factors, to calculate the explained and cumulative variances for each factor dimension, respectively.

In order to investigate the data suitability of the sample mass according to the main population for the EFA, Kaiser-Meyer-Olkin (KMO) and Bartlett's test of Sphericity were used in the research. KMO, the adequacy criterion of the sample size should be in acceptable confidence interval (between 0.50 and 1.00). On the other hand, the correlation matrix should be different from the unit matrix in Bartlett's test of Sphericity explaining the relationship among the variables depending on the correlation matrix calculated between each pair of variables.

Whereas determining the main factor number with the EFA, the factors with Eigenvalues greater than 1 or equal to 1 were taken into consideration statistically. Rotation technique was also used to be able to give easily the factor names, and to eliminate the variable overlapes in factor matrices. In the rotation process, the factors in the axes are rotated so that reducing the variable loads to optimal levels. Rotation could be applied in two groups as vertical (orthogonal) and oblique rotation. While it could be minimized the relationships among the factor dimensions at

Table 2 - Consumers' demographic and socioeconomic attributes according to their three income groups.

Attributes			*Consumers' income groups*			*Overall*
			Low income	*Middle income*	*High income*	
Gender	*Male*	*f*	70	98	69	237
		%	64	59	62	62
	Famale	*f*	39	67	42	148
		%	36	41	38	38
Education	*Illiterate*	*f*	28	54	32	134
		%	35	33	29	32
	Elementary school	*f*	41	33	9	83
		%	38	20	9	22
	Secondary school	*f*	21	31	17	69
		%	19	19	15	18
	High school	*f*	9	47	53	109
		%	8	28	47	28
Profession	*Manager*	*f*	4	14	41	59
		%	4	8	36	16
	White-collar	*f*	2	21	24	47
		%	2	13	22	12
	Blue-collar	*f*	68	59	15	142
		%	62	36	14	37
	Retailer	*f*	10	29	17	56
		%	9	18	15	15
	Others	*f*	25	42	14	81
		%	23	25	13	22
Age (year)		$\bar{x}$	28.98	31.35	35.94	32.00
		SD	8.978	11.111	12.762	11.371
Family size (individual)		$\bar{x}$	4.56	7.47	11.38	7.77
		SD	1.572	1.983	3.579	3.579
Red meat consump. per capita (kg/year)		$\bar{x}$	19.11	14.50	13.15	14.70
		SD	3.885	3.341	5.698	4.731
Monthly total expenditure ($)		$\bar{x}$	277.25	524.30	835.86	544.18
		SD	78.821	*118.214*	202.365	253.838
Monthly food expenditure ($)		$\bar{x}$	148.49	261.44	378.02	263.07
		SD	58.514	73.422	130.988	125.398

vertical rotation, it could be accepted the relative relations among them at oblique rotation. It is often used the varimax, quartimax and equamax methods for vertical rotation techniques, however, it is generally used direct oblimin and promax methods for oblique rotation ones. In this study, therefore, it was applied the vertical rotation technique and its varimax method to minimize the relationships among the factors.

On the other hand, to retain and select the items under each factor dimension on rotated component matrix in the EFA, the factor loads with range 0.30 and 0.50 score are generally accepted for the cut-off threshold of the items depending on number of the items on scaling instrument and sample size reflecting main population (Civelek, 2020; Bursal, 2019; Quy and Ha, 2018; Hair *et al.*, 2014; Chin and Salisburg, 1997). These authors suggested that, thus, if the sample size was more than 300 cases, the cut-off

threshold of factor load was accepted as 0.30, also if the sample size was between 300 and 200 cases and between 200 and 150 cases, the cut-off thresholds of factor loads would be considered as 0.40 and 0.50, respectively.

In the second step, it was used the cluster analysis, two-step cluster analysis, dividing a heterogenic target mass into two or more homogeneous segments by taking into account their attributes such as socioeconomic, psychological and individual characteristics (Karagöz, 2019; Topcu and Baran, 2017). Two-step cluster analysis considering the ideal numbers of clusters and yielding the relationships between the main factors obtained and the consumption groups desired to be created is one of the most effective clustering technique. In the present study, the main factors impacting on Somalia consumers' camel meat consumption satisfactions were used for two-step cluster analysis considering their income groups.

It was analytically segmented, thus, target consumers into three groups as low (less than $400), medium ($400-$850) and high (over $850) income groups. Low, middle and high income groups constituted 28.3% (109 households), 42.9% (165 households) and 28.8% (111 households) of the sample size, respectively. Some demographic and socioeconomic attribute profiles of the target consumer segments according to their income groups were given in Table 2.

4. Results and discussion

4.1. *The result of the EFA related to consumers' camel meat consumption satisfaction*

The goodness fit statistics results and four factor dimensions that consider 27 items impacting on Somalia consumers' camel meat consumption satisfaction in the EFA by being eliminated their load overlap and meaningless loads were given in Table 3. Kaiser Normalization (KMO) that compares the observation and partial correlation coefficients in the EFA was calculated as a value of 0.955 ($p<0.05$). The test score was acceptable at an excellent level due to much closer to the 0.99 threshold value, thus, providing the confirmation of sampling adequacy for the EFA. Bartlett's test of Sphericity statistics for the main factors related to consumers' attitude and behaviors, then, was calculated as =7225.96 ($p=0.000$), and unit matrix hypothesis was rejected ($p<0.001$). Two statistics evaluating the sample data set indicated that the data was at an excellent level for the EFA.

The results of the EFA indicated that the four-factor solution with Eigenvalue scores being greater than 1.0 were derived from 27 items impacting on the consumers' camel meat consumption satisfaction (Table 3). The main four factors were logically identified as the sensory, hedonic and real qualities, and healthy diet willingness, and their total variance explained about 64.05%. The first factor referring to the sensory quality explained 51.68% of total variance. It was thus assessed that sensory quality possessed the loaded items measuring a wide range of sensory perceptions such as the visual and experimental quality faithfulness based on the region of origin strengthening the consumers' camel meat consumption satisfaction.

It was also analyzed that the hedonic quality motived effectively the consumers' camel meat consumption hedonism, the second preference factor, reflected attituditinally the accual camel meat image based on product (meat sources and its safety), price (meat prices and discounts) and distribution (sales points and trust to retailer) mixes.

It was informed in previous researches that the sensory and hedonic quality attributes were the most important motivation drivers on consumers' red meat consumption satisfaction (Topcu, 2022a; Holman and Hopkins 2021; Martins *et al.*, 2021; Popoola *et al.*, 2022; Gültekin and Soro, 2020; Topcu *et al.*, 2015). It was also reported that these factors were the determinaters of the other factors, and were of a strong interaction with the others on consumers' consumption attitudes (Topcu, 2022b, Santos *et al.*, 2021; Fiorentini *et al.*, 2020; Taylor *et al.*, 2020; Hassan *et al.*, 2018).

With the similar requirements, a healthy life and core benefit motives shaping Somalia consumers' camel meat consumption satisfaction and purchase patterns caused the camel meat' real quality and healty diet willingness to form

Table 3 - The results of EFA related to consumers' camel meat consumption preference factors and their variable loads.

The items and factors interpretions	*Factors and ites loadings*			
	F1	*F2*	*F3*	*F4*
Sensory quality				
Consistency (juiciness)	**0.739**	0.257	0.276	0.173
The region of origin of meat source	**0.649**	0.191	0.455	0.102
Smell or odour	**0.645**	0.415	0.152	0.280
Pasture-based feeding	**0.640**	0.137	0.309	0.335
Meat quality	**0.578**	0.377	0.342	0.092
Organic conditions	**0.558**	0.289	0.327	0.270
Taste and flavor	**0.553**	0.509	0.029	0.349
Meat texture	**0.547**	0.309	0.258	0.379
Color and brilliance	**0.527**	0.351	0.183	0.378
Hedonic quality				
Meat source (sheep/goat)	0.241	**0.704**	0.163	0.218
Sales point	0.391	**0.694**	0.234	0.097
Price level	0.245	**0.669**	0.305	0.163
Meat source (beef)	0.262	**0.649**	0.279	0.145
Special discount	0.194	**0.634**	0.327	0.270
Food safety	0.238	**0.555**	0.303	0.448
Trust to retailer	0.202	**0.554**	0.334	0.380
Real quality				
Animal gender	0.170	0.241	**0.752**	0.162
Animal age	0.473	0.214	**0.623**	0.091
Antibiotic-free content in meat	0.259	0.340	**0.615**	0.257
Nutrition value	0.282	0.176	**0.614**	0.405
Nutritional information	0.324	0.335	**0.599**	0.289
Carcass area of meat cutted	0.195	0.395	**0.577**	0.273
Freshness	0.441	0.259	**0.555**	0.120
Healthy diet willingness				
Being healthy for diet	0.346	0.180	0.066	**0.754**
Meat-borne disease concern	0.036	0.336	0.356	**0.660**
Vitamin richness	0.342	0.227	0.350	**0.568**
Protein richness	0.327	0.236	0.397	**0.549**
Eigenvalues	***13.953***	***1.188***	***1.188***	***1.021***
Explained share of variance (%)	*51.676*	*4.398*	*4.194*	*3.783*
Cumulative share of variance (%)	*51.676*	*56.075*	*60.269*	*64.052*
KMO (Kaiser-Meyer-Olkin) statistic				*0.955*
Bartlett's test of sphericity	$[Chi - square\ (\chi^2_{351,0.05} = 7225.96\ (P = 0.000)]$			

**Bold colour values indicated the high load scores of the variables deriving the main factors.*

the third and fourth factors. The real meat quality factor covered the age and gender of meat source animal, nutrition information, chemical-free components and freshness of edebile meat and the cutting areas of the meat on the carcass, and thus there was an increasing conciderable correlation between their meat consumption satisfaction and the meat real quality attributes. Similarly, the healthy diet willingness factor also consisted of the main trace substances and protein components in meat, as well as willingness to eat meat free from meat-oriented disease concerns.

Based on real meat quality and healthy diet

willingness on consumers' choices and their purchasing decisions of red meat, the various researches emphased that the real meat quality was one of the most crusial prerequisions for a healtyhy and balanced diet on consumer attitudes towards red meat consumption and his/her purchase patterns, being of the higher nutritional value (vitamin, protein and mineral substances), natural/organic red meats with chemical-free (Magalhaes *et al.*, 2023; Boito *et al.*, 2021; Burnier *et al.*, 2021; Bonnet *et al.*, 2020; Henchion *et al.*, 2017).

4.2. *The results of EFA related to the factors mitigating the impacts of climate change*

The EFA goodness-fit statistics and two factor dimensions resulting from 14 items assosiating to the impacts of climate change induce by the consumers' camel meat consumption by being eliminated their load overlap and meaningless loads were yielded in Table 4. KMO comparing the observation and partial correlation coefficients in the EFA was calculated as a value of 0.951 ($p<0.05$). The test statistic score was acceptable at an excellent level due to much closer to the 0.99 threshold value, thus, providing the approvation of sampling adequacy for the EFA. Bartlett's test of Sphericity statistics for the main factors related to consumers' attitude and behaviors, then, was founded as , and unit matrix hypothesis was rejected ($p<0.001$). Two statistics evaluating the sample data set indicated that, thus, the data was at an excellent level for the EFA.

The results of the EFA showed that the two-factor solution with Eigenvalue scores being greater than 1.0 was derived from 14 items impacting on the consumers' camel meat consumption satisfaction (Table 4). The main factors were also identified as ecological footprint in livestock and animal care and feeding management, and their explained total variance ratio found to be about %70.27. It was thus evaluated that the ecological footprint in livestock was for a string association with the loaded items measuring a wide range of mitigating the effects of climate change factors, which include in CO_2, CH_4 and N_2O emmisions, power use, red meat consumption, chemical applications, management of potential water sources and lands, and animal welfare to be affected considerably the consumers' camel meat consumption satisfaction.

It could be suggested that the animal care and feeding management would be mitigated gradually the effects of climate change by being preferred livestock product consumptions of the farms adopting the strategical approaches such as good agricultural applications, uses of higher quality feeds and herd species, effective feed regime and wast management, care and feeding at high technological animal shelters as well as expansion of the farms with animal dieases-free.

In previous studies conducted on the impacts of climate change, it was pointed out that to performe the mismanagement strategies for the livestock farms and industrial processes increasing negatively the impacts of climate change in the last decades were gradually caused to irreparable degragations on human helathy and enviremont (Harguess *et al.*, 2020; Al Quayid, 2019; Sanchez-Sabate and Sabaté, 2019; Neff *et al.*, 2018; Ritchie *et al.*, 2018; Graham and Abrahamse, 2017; Kleemann and Schmidt, 2017; Rana and Paul, 2017). These researches reported more clearly that increasing carbon emission, pollution of the natural resources with the chimicals, heavy water and energy uses, poor management aplicatios at the livestock farms and their industries were caused the negative impacts on climate change by boosting ecological footprint. It was highlighted that, therefore, societies would be suffered to the serious challenges for their livestock product demands along the food supply chain in the near next.

4.3. *The results of Cluster Analysis based on the EFA results*

Provided Somalia consumers' satisfaction by mitagating the impacts of climate change while often consuming the camel meat, the main factors derived from EFA for the low, medium and high income segments shaping under the distributions of their income were given in Table 5. The low-income consumers focused on the main factors related to the healthy diet willingness and the ecological footprint in livestock

Table 4 - The results of the EFA for climate change risk factors related to consumers' camel meat consumption.

Factos interpretions and items	*The factor loads*	
	F1	*F2*
Ecological footprint in livestock		
R1	**0.833**	0.314
R3	**0.826**	0.311
R2	**0.821**	0.305
R4	**0.784**	0.315
R9	**0.754**	0.394
R12	**0.741**	0.363
R20	**0.665**	0.519
R11	**0.638**	0.525
R5	**0.586**	0.463
Animal care and feeding management		
R16	0.333	**0.795**
R15	0.337	**0.785**
R14	0.322	**0.759**
R17	0.282	**0.740**
R18	0.367	**0.712**
Eigen-values	***8.753***	***1.084***
Explained share of variance (%)	*62.521*	*7.744*
Cumulative share of variance (%)	*62.521*	*70.266*
KMO (Kaiser-Meyer-Olkin) statistic		*0.951*
Bartlett's test of Sphericity	$[Chi - square\ (\chi^2_{91,0.05} = 4303.65\ (p = 0.000)]$	

** Bold colour values indicated the high load scores of the variables deriving the main factors.*

impacting on Somalia consumers' camel meat consumption satisfaction.

It was reported by various auothers, indeed, that there was a much strong relationship between being decreased ecological footprint and healthy diet willingness for the livestock product consumption satisfaction (Burnier *et al.*, 2021; Godde *et al.* 2021; Alaanuloluwa Ikhuoso *et al.*, 2020; Ankrah Twumasi and Jiang, 2021; Wreford and Topp, 2020; Rojas-Downing *et al.*, 2017). These authours highlighted that sustainable consumption at the livestock supply chain could be provided to be mitigated the ecological footprints for the livestock production and its industrial processes through the various precautions such as animal welfare, traceability, legal regulations mitigating greenhouse gas emission, a successfully management of the feed and water resources, and optimal animal herd sizes and adaptation to heat stress of their species.

The results of the study presented that the consumers in the middle-income cluster were attitudetionally shaped the purchase patterns reflecting their camel meat consumption hedonism under healthy diets willingness by mitigating the impacts of the ecological footprints in livestock. The target consumers could considerably access to more quality and healthy diets, and thus they could try to satisfy from their camel meat consumption by trying to mitigate the impacts of climate change, with less meat consumption, and with the livestock product preferences of the farms performing good agricultural pratics such as managing successfully the farm and natural resource, working with herd species providing higher adaptation to climate change.

Based on the consumers' meat consumption hedonism, the researches indicated that the hedonic consumption satisfaction were commonly affected adversely by the extrem challenges

Table 5 - The cluster center values related to the consumers'camel meat consumption satisfaction factors and the sample sizes in each cluster.

The main factors	*Clusters*					
	Low income		*Middle income*		*High income*	
	$\bar{x}$	*p*	$\bar{x}$	*p*	$\bar{x}$	*p*
Sensory quality	-0.03	*0.000*	-0.06	*0.000*	**0.12**	*0.000*
Hedonic quality	-0.00	*0.020*	**0.18**	*0.020*	-0.26	*0.020*
Real quality	-0.19	*0.020*	-0.06	*0.020*	**0.27**	*0.020*
Healthy diet willingness	**0.05**	*0.000*	0.01	*0.000*	-0.07	*0.000*
Ecological footprint in livestock	**0.16**	*0.010*	**0.19**	*0.010*	-0.01	*0.010*
Animal care and feeding management	-0.03	*0.000*	-0.11	*0.000*	**0.09**	*0.000*
Number of total cases in each cluster (n)	*109*		*165*		*111*	
Population ratio in each cluster	*28.3*		*42.9*		*28.8*	

** Bold values indicate the highest final cluster center scores in each segment.*
** Total sample size (n): 385.*

such as the impacts of climate change, global economic crises and pandemies (Magalhaes *et al.*, 2023; Mesías *et al.*, 2023; Topcu, 2022a; Burnier *et al.*, 2021; Holman and Hopkins 2021; Martins *et al.*, 2021; Popoola *et al.*, 2022; Gültekin and Soro, 2020). Especially, it was conformed in these researches that the ecological footprints in livestock affecting adversely the red meat supply chain caused the meat and meat products to the excessive price increases and the price variations, lower edebile quality, and to be inaccessible to them, and thus it was often affected negatively the consumers' meat consumption hedonism.

The results of the study arised that the high-income consumers also yielded vital importance to their camel meat consumption satisfaction prioritizing the sensory and real quality attributes by mitigating the negative impacts on climate change through the animal care and feeding management. Analytically, the emotional and real quality attributes reflecting the intrinsic food attributes impacting on camel meat consumption satisfaction associated directly with the effective animal care and feeding management implimentations that provide climate change adaptation.

Analyzing the correlations among the impacts of climate change and the intrinsic food attributes motived meat consumption satisfaction, the researches highlighted that the adaption and mitigation strategies related to animal care and feeding management would positively affect the sensory and real quality attributes on the consumption satisfaction along the meat supply chain by improving the impacts of livestock on climate change (Magalhaes *et al.*, 2022; Topcu, 2022a; Wang and McCarl, 2021; Godde *et al.*, 2020; Rojas-Downing *et al.*, 2017).

5. Conclusions

The results of the research revealed that the main factors based on the preference attributes of camel meat and the impacts of climate change on Somalia consumers' camel meat consumption satisfaction were the sensory, hedonic and real quality, healthy diet willingness, and then the ecological footprint in livestock, and the animal care and feeding management. It was then determined the relations among these main factors and the consumer clusters with the low, midle and highg-income by means two-step cluster analysis.

The results of the analyses highlighted that the low and middle income consumers would access to the healthy diets and consumption hedonism through the consumption strategies mitigating ecological footprints in livestock on their camel meat consumption satisfaction. For sustainable hedonic consumption along camel meat supply chain, it should be taken constantly by public authorities the serious measures mitigating the ecological footprint during camel breeding, the meat production and processing.

In demand-side, to consume the mixed-type plant-based diets, to be oriented the synthetic-based meats and to eat less meat in meal under the impacts of various diet quidline campanies could address among the major measures mitigating the ecological footprint for consumers' sustainable consumption. In supply-side of animal production and processing systems, however, the farmers could considerably contribute to mitigate the negative impacts of livestock on ecological footprint by providing sequestration of carbon through various means, improving the feeds to reduce enteric fermentation, improving manure management, and using more efficient fertilizers.

On the other hand, the present study emphazed that the high-income consumers' camel meat consumption satisfaction was considerably affected from the emotional and real quality attributes under the animal care and feeding management strategies at the livestock farms. It could be thus understood that there was a string interaction between the intrinsic food attributes and the farm management strategies. In the supply-side, camel breeding farmers could effectively adapt farm management strategies to climate change in order to maintain the sensory and real quality attributes of camel meat.

For a sustainable consumption under animal food supply safety and security, the farmers, therefore, could comprehensively adapt the livestock system management strategies to climate change by diversifing camel herd species and forages, changing breeding strategies (tolerance to heat stresses and the diseases), adopting scientific and technological advances, implementing the institutional and policy changes. All these measures would not conribute to adapt only the camel breeders' farm management strategies to climate change, but could also provide possibility to ratain the consumers' camel meat consumption satisfaction.

Although this study was one of the first researches conducted on consumers'camel meat consumption satisfaction in the economics literature, it also was of some limitaions. In the study, thus, several limitations could be addressed for the next researches. Firstly, the study only focused on the consumers in Mogadishu, Somalia due to funding and time constrains. The future researches, thus, could be conducted for the larger sample sizes accounting the consumers residing in more important trade centers such as Hargeisa, Burao, and Bossasso of Somalia. Secondly, the study was only conducted on camel meat consumption; however, the next researches could design on the consumers' consumption satisfaction towards beef, sheep and goat meats. Thirdly, it was used the EFA as the research model in the study, but it could be also applied the Confirmatory Factor Analysis (CFA) for the future researches.

References

Aksu G., Eser M.T., Güzeller C.O., 2017. Structural equation model applications with e*xploratory and confirmatory factor analysis under SEM*. Ankara: Detay Publishing.

Alaanuloluwa Ikhuoso O., Adegbeye M.J., Elghandour M.M.Y., Mellado M., Al-Dobaib S.N., Salem A.Z.M., 2020. Climate change and agriculture: The competition for limited resources amidst crop farmers-livestock herding conflict in Nigeria: A review. *Journal of Cleaner Production*, 272: 123104.

Ali Z.B., Çalışkan, V., 2019. Somalia camel-dealing and geography of camel culture: case study of Hiiraan Region. In: *1st Istanbul International Geography Congress Proceedings Book*, June 20-22, Istanbul, Turkey. İstanbul: İstanbul University Press.

Al Quayid A., Al Muhanna S., Mollet P., 2019. *The Political Feasibility of Enhancing Greenhouse Gas Emissions Targets in the European Union's Mid-Century Strategy*. Riyadh: KAPSARC, pp. 1-24.

Ankrah Twumasi M., Jiang Y., 2021. The impact of climate change coping and adaptation strategies on livestock farmers' technical efficiency: the case of rural Ghana. *Environmental Science and Pollution Research*, 28: 14386-14400.

Badar H., Abbas A., Mushtaq K., Dogot T., Lebailly P., Parra-Acosta Y.K, Azadi H. López-Carr D., 2023. Unravelling consumer preferences and segments: Implications for Pakistan's Mandarin industry development through market relocation. *Land*, 12: 953.

Barnes A.P., Islam Md.M., Toma L., 2013. Heterogeneity in climate change risk perception amongst dairy farmers: A latent class clustering analysis. *Applied Geography*, 41: 105-115.

Bellarby J., Tirado R., Leip A., Weiss F., Lesschen J.P., Smith P., 2013. Livestock greenhouse gas emissions and mitigation potential in Europe. *Global Change Biology*, 19(1): 3-18.

Boito B., Lisbinski E., Del Mar Campo M., Guerrero A., Resconi V., Esteves de Oliveira T., Barcellos J.O.J., 2021. Perception of beef quality for Spanish and Brazilian consumers. *Meat Science*, 172: 108312.

Bonnet C., Bouamra-Mechemache Z., Réquillart V., Treich N., 2020. Viewpoint: Regulating meat consumption to improve health, the environment and animal welfare. *Food Policy*, 97: 101847.

Bouranta N., Psomas E., Casolani N., Jaca C., Liberatore L., 2022. Consumers' food safety perceptions in three Mediterranean countries. *New Medit*, 21(4): 71-84. https://doi.org/10.30682/nm2204f.

Burnier P.C., Spers E.E., de Barcellos M.D., 2021. Role of sustainability attributes and occasion matters in determining consumers' beef choice. *Food Quality and Preference*, 88: 104075.

Bursal M., 2019. *Basic Data Analyses with SPSS* (extended 2nd edition). Ankara: Anı Publising.

Chin W.W., Gopal A., Salisbury W.D., 1997. Advancing the theory of adaptive structuration: The development of a scale to measure faithfulness of appropriation. *Information Systems Research*, 8(4): 321-422.

Civelek M.E., 2020. *Methodology of Structural Equation Model*. İstanbul: Beta Printing and Publishing Inc.

Delgado R.T., Flores J.S.M., 2015. Factors affecting beef consumption in the valley of Mexico. *Revista Brasileira de Zootecnia*, 44(10): 371-376.

FAO, 2013. *Climate-smart agriculture: Sourcebook*. Rome: FAO. Retrieved on March 15, 2023 from http://www.fao.org/3/a-i3325e.pdf.

Fiorentini M., Kinchla A.J., Nolden A.A., 2020. Role of sensory evaluation in consumer acceptance of plant-based meat analogs and meat extenders: A scoping review. *Foods*, 9(9): 1334.

Gerber P.J., Steinfeld H., Henderson B., Mottet A., Opio C., Dijkman J., Falcucci A., Tempio G., 2013. *Tackling climate change through livestock: A global assessment of emissions and mitigation opportunities*. Rome: FAO.

Godde C.M., Mason-D'Croz D., Mayberry D.E., Thornton P.K., Herrero M., 2021. Impacts of climate change on the livestock food supply chain; a review of the evidence. *Global Food Security*, 28: 100488.

Godfray H.C.J., Aveyard P., Garnett T., Hall J.W., Key T.J., Lorimer J., Pierrehumbert R.T., Scarborough P., Springmann M., Jebb S.A., 2018. Meat consumption, health, and the environment. *Science*, 361(6399): eaam5324.

Graham T., Abrahamse W., 2017. Communicating the climate impacts of meat consumption: The effect of values and message framing. *Global Environmental Change*, 44: 98-108.

Gültekin U., Soro N.Y., 2020. Red meat consumption structure and consumer behavior in the urban area of Adana Province. *Çukurova Tarım ve Gıda Bilimleri Dergisi*, 35(2): 143-150.

Gündüz O., Esengün K., Göktolga Z.G., 2006. *Ailelerin et tüketimleri üzerine bir araştırma: Tokat ili örneği*. VII. Tarım Ekonomisi Kongresi, Antalya, Türkiye, 13 Eylül 2006.

Harguess J.M., Crespo N.C., Hong M.Y., 2020. Strategies to reduce meat consumption: A systematic literature review of experimental studies. *Appetite*, 144: 104478.

Hair J.F., Black B., Babin B., Anderson R.E., 2014. *Multivariate Data Analysis*, 7th ed. Harlow: Pearson Education Limited.

Hassan M.A., Abdel-Naeem H.H., Mohamed H.M., Yassien N.A., 2018. Comparing the physico-chemical characteristics and sensory attributes of imported brazilian beef meat and imported indian buffalo meat. *Journal of Microbiology, Biotechnology and Food Sciences*, 8(1): 672-677.

Henchion M.M., McCarthy M., Resconi V.C., 2017. Beef quality attributes: A systematic review of consumer perspectives. *Meat Science*, 128: 1-7.

Henry B., Charmley E., Eckar, R., Gaughan J.B., Hegarty R., 2012. Livestock production in a changing climate: adaptation and mitigation research in Australia. *Crop & Pasture Science*, 63: 191-202.

Holman B.W., Hopkins D.L., 2021. The use of conventional laboratory-based methods to predict consumer acceptance of beef and sheep meat. *Meat Science*, 181: 108586.

Karagöz Y., 2019. *Statistical Analyses with SPSS and AMOS Application*. Ankara: Nobel Academic Publishing.

Karakuş K., Aygün T., Alarslan E., 2008. Gaziantep ili merkez ilçede kırmızı et tüketim alışkanlıkları. Yüzüncüyı Üniversitesi, Ziraat Fakültesi, Tarım Bilimleri Dergisi. *Journal of Agricultural Sciences*, 18(2): 113-120.

Kleemann S., Schmidt U.J., 2017. Reducing meat consumption in developed and transition countries to counter climate change and biodiversity loss: A review of influence factors. *Regional Environmental Change*, 17: 1261-1277.

Magalhaes D.R., Çakmakçı C., del Mar Campo M., Çakmakçı Y., Makishi F., dos Santoa Silva V.L., Trindade M.A., 2023. Changes in the current patterns of beef consumption and consumer behavior trends – Cross-cultural study Brazil-Spain-Turkey. *Foods*, 12(3): 475.

Magalhaes D.R., Maza M.T., do Prado I.N., Fiorentini G., Kirinus J.K., del Mar Campo M., 2022. An

Exploratory study of the purchase and consumption of beef: Geographical and cultural differences between Spain and Brazil. *Foods*, 11(1): 129.

Malhotra N.K., 1993. *Marketing Research: An Applied Orientation*. Hoboken, NJ: Prentice Hall International.

Martins M.M., Saldaña E., Bortoluzzi Teixeira A.C., Selani M.M., Contreras-Castillo C.J., 2021. Going beyond sensory and hedonic aspects: A Brazilian study of emotions evoked by beef in different contexts. *Meat Science*, 180: 108536.

Mesías J.F., Fernández J.A., Horrillo A., Escribano A.J., 2023. An Approach to the perceptions of Spanish consumers on food sustainability through the use of projective techniques. *New Medit*, 22(1): 35-52.

Motoki K., Saito T., Nouchi R., Kawashima R., Sugiura M., 2018. The paradox of warmth: Ambient warm temperature decreases preference for savory foods. *Food Quality and Preference*, 69: 1-9.

Neff R.A., Edwards D., Palmer A., Ramsing R., Righter A., Wolfson J., 2018. Reducing meat consumption in the USA: a nationally representative survey of attitudes and behaviours. *Public Health Nutrition*, 21(10): 1835-1844.

OECD/FAO, 2021. *World red meat consumption amounts*. In: OECD Agriculture Statistics (database). Retrieved in July 15, 2022 from https://data.oecd.org/agroutput/meat-consumption.htm.

Polley H.W., Briske D.D., Morgan J.A., Wolter K., Bailey D.W., Brown J.R., 2013. Climate change and North American rangelands: Trends, projections, and implications. *Rangeland Ecology & Management*, 66(5): 493-511.

Popoola I.O., Soladoye P.O., Gaudette N.J., Wismer W.V., 2022. A Review of sensory and consumer-related factors influencing the acceptance of red meats from alternative animal species. *Food Reviews International*, 38(sup1): 266-285.

Quy H., Ha T., 2018. An empirical assessment of public policy communications in Central Region of Vietnam. *Modern Economy*, 9(12): 2052-2063.

Rana J., Paul J., 2017. Consumer behavior and purchase intention for organic food: A review and research agenda. *Journal of Retailing and Consumer Services*, 38: 157-165.

Ritchie H., Reay D.S., Higgins P., 2018. The impact of global dietary guidelines on climate change. *Global Environmental Change*, 49: 46-55.

Rojas-Downing M.M., Nejadhashemi A.P., Harrigan T., Woznicki S.A., 2017. Climate change and livestock: Impacts, adaptation, and mitigation. *Climate Risk Management*, 16: 145-163.

Sanchez-Sabate R., Sabaté J., 2019. Consumer attitudes towards environmental concerns of meat consumption: A systematic review. *International Journal of Environmental Research and Public Health*, 16(7): 1220.

Santos D., Monteiro M.J., Voss H.P., Komora N., Teixeira P., Pintado M., 2021. The most important attributes of beef sensory quality and production variables that can affect it: A review. *Livestock Science*, 250: 104573.

Taylor J., Ahmed I.A.M., Al-Juhaimi F.Y., Bekhit A.E.D.A., 2020. Consumers' perceptions and sensory properties of beef patty analogues. *Foods*, 9(1): 63-71.

Topcu Y., 2022a. Evaluating veal consumption hedonism of consumers by mediating effect model with risk factor. *Turkish Journal of Agriculture - Food Science and Technology*, 10(3): 394-403.

Topcu, Y. 2022b. Consumers' veal consumption preferences under climate changes and Covid-19 pandemic: Case of Erzurum Province. *GOP Bilimsel Araştırma Dergisi*, 13(1): 1-13.

Topcu Y., Baran D., 2017. Marketing strategies based on consumer preferences of Karnavas mullberry molasses with Protected Designation of Origin (PDO). *Turkish Journal of Agriculture - Food Science and Technology*, 5(7): 822-831.

Topcu Y., Uzundumlu A., Baran D., 2015. How sensory and hedonic quality attributes affect fresh red meat consumption decision of Turkish consumers? *Italian Journal of Food Science*, 27: 181-190.

Tosun Ö.O., Hatirli S.A., 2009. Tüketicilerin kırmızı et satın alım yerleri tercihlerinin analizi: Antalya ili örneği. *Süleyman Demirel Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*: 14(2): 433-445.

Wang B., Shen C., Cai Y., Liu D., Gai S., 2022. The purchase willingness of consumers for red meat in China. *Meat Science*, 192: 108908.

Wang M., McCarl B.A., 2021. Impacts of climate change on livestock location in the US: A statistical analysis. *Land*, 10(11): 1260.

Willett W., Rockström J., Loken B., Springmann M., Lang T., Vermeulen S., Garnett T., Tilman D., DeClerck F., Wood A., Jonell M. *et al.*, 2019. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet*, 393(10170): 447-492.

Wreford A., Topp C.F.E., 2020. Impacts of climate change on livestock and possible adaptations: A case study of the United Kingdom. *Agricultural Systems*, 178: 102737.