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CONSUMERS' ATTITUDES AND PREFERENCES TOWARDS HERITAGE CEREALS AND SOURDOUGH BREADS

ATITUDES E PREFERÊNCIAS DOS CONSUMIDORES EM RELAÇÃO A CEREAIS TRADICIONAIS E PÃES DE FERMENTAÇÃO NATURAL

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Abstract

Bread is one of the most consumed staple foods in the world. With rising consumer awareness, interest in ancient grains and sourdough breads has increased. Interest in these breads is growing with healthy living, sustainability, and environmentally friendly approaches. Data were collected through face-to-face interviews with 415 people in Türkiye, a historically important region for ancient grains and sourdough. Consumers' bread purchasing habits, knowledge of heritage grains, the amount and variety of bread consumed, and their interest in health were determined. Chi-square analysis of the survey results indicated that the amount and variety of bread consumed are significantly influenced by individuals' socio-demographic characteristics. Among consumers, women, middle-aged individuals (36-55), individuals with a bachelor's degree (or higher), and those with a middle- to upper-middle income level place greater emphasis on the consumption of these breads. While people have a positive attitude toward sourdough bread and consume it frequently and in significant quantities, lower-income groups prefer to consume more bread at a lower price. With developing technology, communication networks, social media and logistics, people's interest and knowledge in healthy nutrition, sustainability, biodiversity and environmental protection instincts have become even more important.

Keywords: Consumer Attitudes. Ancient Cereals. Sourdough. Healthy Breads. Traditional.

Resumo

O pão é um dos alimentos básicos mais consumidos no mundo. Com a crescente conscientização do consumidor, o interesse por grãos ancestrais e pães de fermentação natural aumentou. Esse interesse cresce impulsionado por uma vida saudável, sustentabilidade e abordagens ecologicamente corretas. Os dados foram coletados por meio de entrevistas presenciais com 415 pessoas na Turquia, uma região historicamente importante para grãos ancestrais e fermentação natural. Foram determinados os hábitos de compra de pão dos consumidores, o conhecimento sobre grãos ancestrais, a quantidade e a variedade de pão consumido e seu interesse em saúde. A análise do qui-quadrado dos resultados da pesquisa indicou que a quantidade e a variedade de pão consumido são significativamente influenciadas pelas características sociodemográficas dos indivíduos. Entre os consumidores, mulheres, indivíduos de meia-idade (36-55 anos), indivíduos com diploma de bacharelado (ou superior) e aqueles com renda média a média-alta dão maior ênfase ao consumo desses pães. Embora as pessoas tenham uma atitude positiva em relação ao pão de fermentação natural e o consumam com frequência e em quantidades significativas, os grupos de baixa renda preferem consumir mais pão a um preço mais baixo. Com o desenvolvimento da tecnologia, das redes de comunicação, das mídias sociais e da logística, o interesse e o conhecimento das pessoas em alimentação saudável, sustentabilidade, biodiversidade e instintos de proteção ambiental tornaram-se ainda mais importantes.

Palavras-chave: *Atitudes do consumidor. Cereais ancestrais. Fermentação natural. Pães saudáveis. Tradicional.*

1 INTRODUCTION

Cereals have been one of the most consumed foods by human beings since their existence on earth (Bangar and Kaushik, 2022). Bread is produced by grinding grains into flour and mixing them with water (addition of other ingredients if desired) to turn them into an attractive, tasty and digestible food (Finnie and Atwell, 2016). With the use of sourdough in bread making, significant improvements are achieved in terms of the textural properties of the bread (high volume, soft and elastic crumb structure), microbiological properties (hygienic safety, longer shelf life), nutritional value (high and diverse aroma and nutrients) and health effects (high digestibility, breakdown of anti-nutrients) (Siepmann *et al*., 2018; Chavan and Chavan, 2011). Einkorn, emmer, and spelt wheat, the ancestors of today's grains, are called "ancient grains" (Baloch *et al*., 2022). “Ancient, cultivated wheats (einkorn, emmer, and spelt) originated in the Fertile Crescent, an area in the Middle East spreading from Jordan, Palestine, and Lebanon to Syria, Turkey, Iraq, and Iran” (Baloch *et al*., 2022; Arzani and Ashraf, 2017). In Turkey, one of the first places where agriculture was first practiced, einkorn wheat (*Aegilops monococcum L.*) was first cultivated near Diyarbakır Karacadağ approximately 10 thousand years ago. Before modern bread wheat varieties became widespread, primitive cultural forms of wheat such as einkorn (*Triticum monococcum*) and emmer (*T. dicoccon*) were cultivated in Anatolia (WWF, 2025). Consumers have turned to foods made from ancient grains for reasons such as the tendency towards healthy eating, sustainability, preference for additive-free foods and the desire to consume traditional foods (Valsalan *et al*., 2024; Arzani and Ashraf, 2017). In addition, ancient grains can be grown in better conditions (tolerance to environmental stresses, low agricultural input, resistance to diseases, etc.) and provide positive ecological effects on the environment (Valsalan *et al*., 2025). The most commonly produced types of wheat among ancient grains are spelt, einkorn, emmer and kamut (Șerban *et al*., 2021). Ancient wheats are claimed to be healthier than modern wheats **(**Șerban *et al*., 2021). According to many studies, the micro

and macro nutrients, functional and bioactive components found in ancient wheats provide positive effects on health and improve the nutritional value of cereal products produced from these wheats (Sik *et al*., 2024; Temizgul *et al*., 2024; Arslan Unal and Ozkaya, 2024; Majzoobi *et al*., 2023; Roumia *et al*., 2023; Pal and Molnár, 2021; Baniwal *et al*., 2021; Zamaratskaia *et al*., 2021). There are many desired changes as a result of bread making with sourdough fermentation of ancient wheats, and as the fermentation time increases, the beneficial components for health increase (Păucean *et al*., 2024), and the composition of the bread is enriched according to the type of raw material used. (Ribet *et al*., 2024). For example, the dietary fiber content, which is known to be important for human intestinal health, is higher in ancient grains compared to modern wheat (Cetiner and Koksel, 2024). Sourdough fermentation causes positive transformations such as suplying macro and micronutrient needs, reducing mineral deficiencies, lowering blood cholesterol levels, preventing diseases such as gluten intolerance and diabetes, and breaking down anti-nutrients. (Rolim *et al*., 2024; Houssni *et al*., 2022; Fernández-Peláez *et al*., 2020).

Due to the increase in diseases caused by the consumption of food additives and ultra- processed foods in the world, people want to avoid them (Pagliai *et al*., 2021; Elizabeth *et al*., 2020,), people want to consume less processed, natural products (Saulais *et al*., 2023), and as a result, the consumption of healthy foods, organic and local foods is increasing (Feldmann and Hamm, 2015). Interest in healthy and nutritious foods has been increasing in recent decades people want to consume more local and ancient foods in Turkey (STATISTA, 2025; Koksel and Cetiner, 2015). Research indicates that ancient grain breads are preferred by consumers for reasons such as being healthy and natural and preserving wheat genetic diversity (Wang *et al*., 2024; Longin and Würschum, 2016). Consumers' attitudes and preferences are important in food consumption. Since people tend to consume more traditional products (STATISTA, 2025), many socio-economic factors affect the preference of artisan bakery products (Mucha, 2024).

This study aimed to determine the attitudes and preferences of consumers towards heritage cereals and sourdough breads. It was determined whether the perspective of consumers towards cereals and breads and the level of consumption and health knowledge were affected by the change in demographic conditions.

2 METHOD

2.1 Questionnaire

In this article the term “heritage cereals” is meant to include landraces, primitive cereals, ancient cereals, older cereal varieties as used Wendin *et al*., (2020), and Guzmán and Alvarez (2021). In the study, breads were divided into two main groups. The first group included other breads (traditional and industrially produced loaf, phyllo-yufka, flatbread-bazlama, lavash-lavaş, tandoori-tandır, pita-pide, daisy/sliced/mini, whole wheat / grain, bran, rye/barley/sunflower containing breads), while the second group, which is qualified breads, included heritage breads, pseudocereals breads (buckwheat, amaranth, quinoa, chia), sourdough breads and gluten-free breads. The second group of breads was named as “qualified breads” because it was the focus of the research topic. The questions used in the study were used after expanding the scope of the survey based on the question set of Wendin *et al*., (2020). Data were collected in Turkey (Konya province, where Çatalhöyük, one of the oldest ancient settlements, is located) in December 2024. A survey was conducted with 415 people through face-to-face interviews, exceeding the number of 384 considered sufficient for the sample from the universe.

2.2 Statistical analysis

The general screening model was used in the study and the obtained data were analyzed using the statistical program (SPSS 27). Non-parametric statistics are used in categorical data (Salas-Parra *et al*., 2023). The chi-square test is also used for both categorical and non-parametric variables. Chi-square (X^2) analysis is a non-parametric test used to test whether there is a relationship between two discontinuous variables and whether the data obtained from one variable differs at the levels of the other variable. The existence of a relationship between two variables indicates that the answers at the levels of one variable differ at the levels of the other variable (Zlokovich *et al*., 2023). Since the data obtained were discontinuous and categorical in the intergroup comparisons, Chi-square (X^2) analysis was performed on the numbers and ratios (%) obtained with a

significance level of 0.05 according to Pearson, a margin of error of 5% and a reliability of 95%, and the data were interpreted.

2.3 Descriptive statistics

The research was conducted with the participation of 415 people, and the frequency distribution of participant information is given in Table 1.

Table 1

Study Sample Characteristics

Sociodemographic Characteristics		Frequency N=415	%
Gender	Female	230	55,4
	Male	185	44,6
Marital Status	Married	285	68,7
	Single	130	31,3
Age	25-35	136	32,8
	36-45	91	21,9
	46-55	85	20,5
	56-65	49	11,8
	66 and above	54	13
Education	Primary and Secondary	158	38,1
	undergraduate	194	46,7
	Master's Degree	50	12
	Doctorate	13	3,1
Job	Private Sector	154	37,1
	Business Owner-Tradesman	69	16,6
	Public Sector	83	20
	Housewife	63	15,2
	Other	46	11,1
Income	0-440 USD	51	12,3
	441-899 USD	126	30,4
	900-1299 USD	122	29,4
	1300-1799 USD	67	16,1
	1800 USD and above*	49	11,8

*1 Turkish Lira: ~38,50 USD. Minimum wage ise 440 USD in Türkiye.

Table 1 shows that the participants consisted of 230 (55.4%) female, 185 (44.6%) male, 68.7% married and 31.3% single. The age distribution of the participants was 32.8% between 25-35 years old, 21.9% between 36-45 years old, 20.5% between 46-55 years old, 11.8% between 56-65 years old, and 13% between 66 years old and above. The participants stated their educational background as primary and secondary school (38.1%), bachelor's degree (46.7%), master's degree (12%), and doctorate degree (3.1%).

The distribution by occupation was private sector (37.1%), business owner-tradesman (16.6%), public sector (20%), housewife (15.2%), and other (11.1%). According to monthly income, the income distribution of the participants was found to be between 0-440 USD (12.3%), between 441-899 USD (30.4%), between 900-1299 USD (29.4%), between 1300-1799 USD (16.1%) and 1800 USD and above (11.8%).

3 RESULTS

In the study, the participants' consumption of cereal products (Fig 1), their knowledge of heritage cereals (Fig 2) and the types of bread they consume (Fig 3) were determined. 88% of the participants in the survey consume bread (Fig 1). It was also determined that a substantial proportion of bakery products are consumed at least once a week. The participants' knowledge of cereals is given in Fig 2, and it is seen that consumers know einkorn wheat the most (66%), as well as buckwheat (63.4%), quinoa (49.9%) and chia seeds (46.7%). When the consumers' bread preferences are examined in detail (Fig 3), their preferences for quality bread consumption are as follows: sourdough breads (39%), ancient cereal breads (12.8%), pseudocereal breads (11.3%) and gluten-free breads (4.6%). When all figures (Fig 1, Fig 2, Fig 3) are taken into consideration, it is concluded that a substantial portion of consumers are sufficiently familiar with breads, but this information is less important during the consumption process. It has been determined that bread is consumed a lot in Turkey (STATISTA, 2025, Fig 1), and that loaves of bread are in high demand (58.3%).

Figure 1

Weekly Consumption Preferences of Consumers for Cereal Products

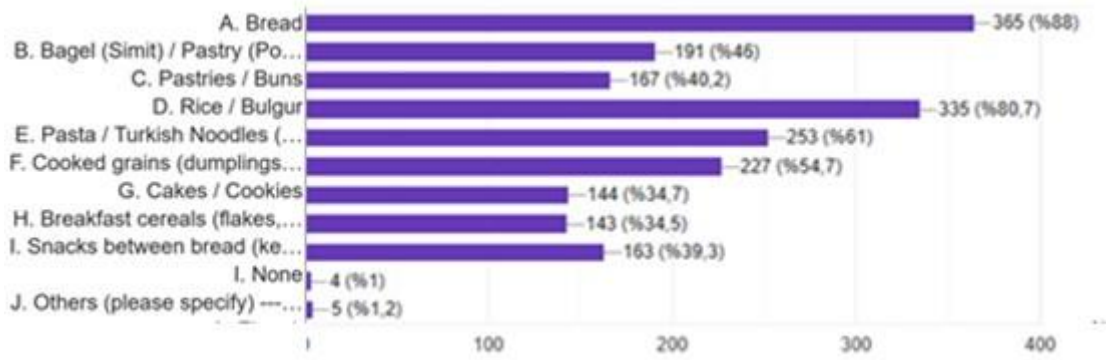


Figure 2

Consumers' Knowledge of Heritage Grains and Pseudocereals

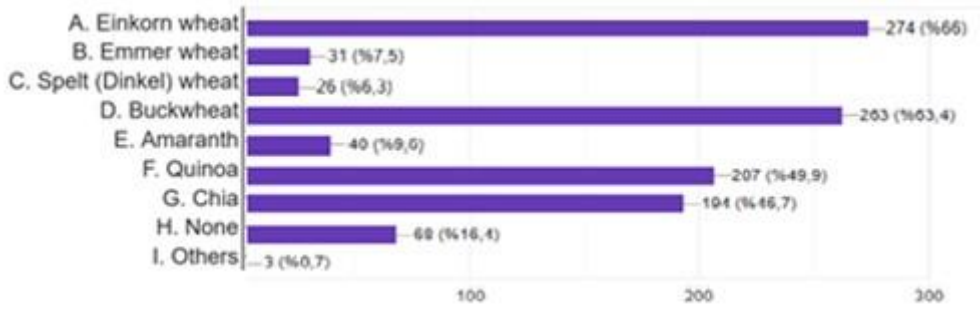
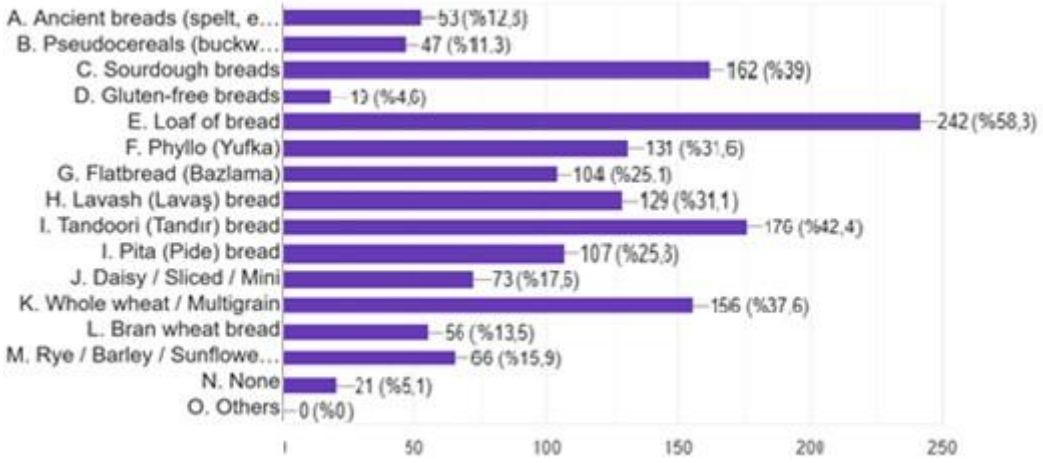


Figure 3

Bread Consumption Preferences of Consumers



Data on where consumers consume bread are as follows (Table 2): The total rate of those who answered 4-most likely and 5-always to the question “How often do you buy bread from the bakery?” is 27.7%. The total rate of those who answered 4 and 5 to the question “How often do you buy bread from the market?” is 10.1%. The total rate of those who answered 4 and 5 to the question “How often do you make bread at home” is 1.4%.

Data on consumers’ preferences for purchasing heritage grain products are shown in Table 3. The question “Would you consider buying bread or other products made from heritage grains?” was answered yes by 83.4%. The question “Would easier access to bread or other products made from heritage grains increase your frequency of consumption?” was answered yes by 80.2% and the question “Are you willing to pay more for products based on heritage grains?” was answered yes by 65.1%.

Consumers' preferences regarding sourdough bread consumption are shown in Table 4. 84.1% of the respondents answered yes to the question "Do you know that sourdough breads are healthier than commercial yeast breads?" 82.2% answered yes to the question "Would easier access to sourdough breads increase your consumption frequency?" 75.7% answered yes to the question "Would the healthier sourdough breads cause you to increase your consumption?" and 69.9% answered yes to the question "Are you willing to pay more for sourdough breads?"

Table 2

Consumers' Attitudes Towards Where They Consume Bread

Where is Bread Consumed?		Frequency N=415	%
How Often Do You Make Bread at Home?	1-Never	268	64,6
	2-Not at all likely	69	16,6
	3-Maybe	50	12
	4-Most likely	22	5,3
	5-Always	6	1,4
How Often Do You Buy Bread from the Bakery?	1-Never	54	13
	2-Not at all likely	48	11,6
	3-Maybe	97	23,4
	4-Most likely	101	24,3
	5-Always	115	27,7
How Often Do You Buy Bread from the Grocery?	1-Never	183	44,1
	2-Not at all likely	98	23,6
	3-Maybe	62	14,9
	4-Most likely	30	7,2
	5-Always	42	10,1

Table 3

Consumers' Purchasing Preferences for Heritage Cereal Products

Heritage Grain Product Purchasing Preference		Frequency N=415	%
Would you consider purchasing bread and bakery products made from heritage grains?	Yes	346	83,4
	No	69	16,6
Would easier access to bread and bakery products made from heritage grains increase the frequency of consumption?	Yes	333	80,2
	No	82	19,8
Are you willing to pay more for products based on heritage grains?	Yes	270	65,1
	No	145	34,9

Table 4

Consumers' Sourdough Bread Consumption Preferences

Sourdough Bread Consumption Preference		Frequency N=415	%
Do you know that sourdough breads are healthier than commercial yeast breads?	Yes	349	84,1
	No	66	15,9
Does the healthier sourdough breads make you increase your consumption amount?	Yes	314	75,7
	No	101	24,3
Does easier access to sourdough breads increase your consumption frequency?	Yes	341	82,2
	No	74	17,8
Are you willing to pay more for sourdough breads?	Yes	290	69,9
	No	125	30,1

3.1 Chi-square analysis

Hypotheses regarding consumers' preferences regarding bread consumption (type of bread H1-11 and qualified breads H12-22) are given in Table 5. All hypotheses (except H9) were accepted.

Table 5

Hypotheses regarding consumers' bread consumption

No	**Hypothesized: The type of bread that consumers prefer differ ...**	**Indicators**		**Confirmation of expectation**
H1	according to gender.	χ^2=13,816, p=0,001*	df=2,	supported
H2	according to age.	χ^2=27,327, p=0,001*	df=8,	supported
H3	according to educational status.	χ^2=51,615, p=0,000*	df=6,	supported
H4	according to income.	χ^2=18,810, p=0,016**	df=8,	supported
H5	depending on whether they consider purchasing products made from heritage grains.	χ^2=25,715, p=0,000*	df=2,	supported
H6	depending on whether they think that easy access to products made from heritage grains will increase the frequency of consumption.	χ^2=22,784, p=0,000*	df=2,	supported
H7	depending on their willingness to pay more for heritage grains.	χ^2=22,394, p=0,000*	df=2,	supported
H8	depending on whether they think sourdough bread is healthier than other commercial yeast breads.	χ^2=37,653, p=0,000*	df=2,	supported
H9	depending on whether they think sourdough bread is healthier and will increase consumption.	χ^2=4,053, p=0,132	df=2,	not

H10	depending on whether they think that easy access to sourdough bread will increase the frequency of consumption.	χ^2=7,111, p=0,029**	df=2,	supported
H11	depending on their willingness to pay more for sourdough bread.	χ^2=27,402, p=0,000*	df=2,	supported

*p<0,001, **p<0,05.

Table 5

(continiued) Hypotheses regarding consumers' bread consumption

No	Hypothesized: Consumers' preferences for qualified bread differ …	Indicators	Confirmation of expectation
H12	according to gender.	χ^2=7,159, df=1, p=0,007**	supported
H13	according to age.	Sourdough breads; χ^2=24,396, df=4, p=0,000*	supported
H14	according to educational status.	Heritage breads (χ^2=24,598, df=3, p=0,000*), Pseudocereal breads (χ^2=15,686, df=3, p=0,001*) and Sourdough breads (χ^2=36,894, df=3, p=0,000*)	supported
H15	according to income.	χ^2=17,154, df=4, p=0,002**	supported
H16	depending on whether they consider purchasing products made from heritage grains.	Heritage breads (χ^2=5,271, df=1, p=0,022**), Pseudocereal breads (χ^2=5,852, df=1, p=0,016**) and Sourdough breads (χ^2=20,948, df=1, p=0,000*)	supported
H17	depending on whether they think that easy access to products made from heritage grains will increase the frequency of consumption.	Heritage breads (χ^2=4,085, df=1, p=0,043**) and Sourdough breads (χ^2=20,714, df=1, p=0,000*)	supported
H18	depending on their willingness to pay more for heritage grains.	Heritage breads (χ^2=22,914, df=1, p=0,000*) and Sourdough breads (χ^2=20,787, df=1, p=0,000*)	supported
H19	depending on whether they think sourdough bread is healthier than other commercial yeast breads.	Heritage breads (χ^2=4,767, df=1, p=0,029**), Pseudocereal breads (χ^2=7,521, df=1, p=0,006**) and Sourdough breads (χ^2=26,655, df=1, p=0,000*)	supported
H20	depending on whether they think sourdough bread is healthier and will increase consumption.	Sourdough breads (χ^2=3,904, df=1, p=0,048**)	supported
H21	depending on whether they think that easy access to sourdough bread will increase the frequency of consumption.	Sourdough breads (χ^2=6,755, df=1, p=0,009**)	supported
H22	depending on their willingness to pay more for sourdough bread.	Heritage breads (χ^2=14,709, df=1, p=0,000*) and Sourdough breads (χ^2=29,576, df=1, p=0,000*)	supported

*p<0,001, **p<0,05.

A statistically significant relationship (χ^2=13.816, df=2, p=0.001) was found between the type of bread consumers eat and gender. H1 hypothesis was accepted. According to the results of chi-square analysis, it is seen that women give more importance to the qualified bread group and men give more importance to the other bread group. A statistically significant relationship (χ^2=27.327, df=8, p=0.001) was found between the type of bread consumers eat and age groups. H2 hypothesis was accepted. The 25-35 age group, 36-45 age group and 46-55 age group give more importance to the qualified bread group than the other groups, while the 66 and above age group gives more importance to the other bread group. A statistically significant relationship (χ^2=51.615, df=6, p=0.000) was found between the type of bread consumers eat and education groups. H3 hypothesis was accepted. People with doctoral education give more importance to the qualified bread group, while people with primary and secondary education give more importance to the other bread group. A statistically significant relationship (χ^2=18.810, df=8, p=0.016) was found between the type of bread consumers eat and their income groups. H4 hypothesis was accepted. Accordingly, according to the results of the chi-square analysis, it is seen that the group of people with an income of 50,001-70,000 TL attaches more importance to the group of qualified breads, and the group of people with an income of 0-17,002 TL attaches more importance to the group of other breads. A statistically significant relationship (χ^2=25.715, df=2, p=0.000) was found between the type of bread consumers eat and their intention to buy products made from ancestral grains. H5 hypothesis was accepted. Accordingly, according to the results of the chi-square analysis, it is seen that the group of people who consider buying products made from ancestral grains attaches more importance to the group of qualified breads. A statistically significant relationship (χ^2=22.784, df=2, p=0.000) was found between the type of bread consumers eat and the fact that easier access to heritage grains increases the frequency of consumption. H6 hypothesis was accepted. The group that thinks that easier access to products made from heritage grains will increase consumption attaches more importance to the group of specialty breads. A statistically significant relationship (χ^2=22.394, df=2, p=0.000) was found between the type of bread consumers eat and their willingness to pay more for products made from heritage grains. H7 hypothesis was accepted. The group willing to pay more for heritage grains gives more importance to the other bread group. A statistically significant relationship (χ^2=37.653, df=2, p=0.000) was found between the type of bread consumers eat and their perception of sourdough breads

being healthier than other commercial yeast breads. H8 hypothesis was accepted. Those who think sourdough bread is healthier give more importance to the qualified bread group. No statistically significant relationship (χ^2=4.053, df=2, p=0.132) was found between the type of bread consumers eat and their belief that sourdough breads would increase their consumption because they are healthier. Hypothesis H9 was rejected. A statistically significant relationship (χ^2=7.111, df=2, p=0.029) was found between the type of bread consumers eat and the belief that easier access to sourdough breads will increase their consumption frequency. H10 hypothesis was accepted. Accordingly, the group that believes that easier access to sourdough breads will increase their consumption frequency attaches more importance to the qualified breads group. A statistically significant relationship (χ^2=27.402, df=2, p=0.000) was found between the type of bread consumers eat and their willingness to pay more for sourdough breads. H11 hypothesis was accepted. Accordingly, the group that believes that easier access to sourdough breads will increase their consumption frequency attaches more importance to the other breads group. A statistically significant relationship (χ^2=7.159, df=1, p=0.007) was found between the preference of quality breads and gender. H12 hypothesis was accepted. It can be said that women give more importance to sourdough breads. A statistically significant relationship (χ^2=24.396, df=4, p=0.000) was found between quality breads and the age status of consumers. H13 hypothesis was accepted. Other age groups, except for the 66 and over age group, give more importance to sourdough breads. A statistically significant relationship was found between the preferences of heritage breads (χ^2=24.598, df=3, p=0.000), pseudocereal breads (χ^2=15.686, df=3, p=0.001) and sourdough breads (χ^2=36.894, df=3, p=0.000) and the educational status of the consumers. H14 hypothesis was accepted. According to the chi-square analysis results, the choices of qualified breads are as follows: It can be said that bachelor's degree, master's degree, and doctorate degree education groups give more importance to heritage breads, undergraduate and graduate education groups give more importance to pseudocereal breads, and bachelor's degree, master's degree, and doctorate degree education groups give more importance to sourdough breads. A statistically significant relationship was found between the consumers' preference for qualified breads and their income status (χ^2=17.154, df=4, p=0.002). H15 hypothesis was accepted. The 0-440 USD income group attaches less importance to sourdough breads than other income groups. A statistically significant relationship was found between the preferences of consumers for heritage breads

(χ^2=5.271, df=1, p=0.022), pseudocereal breads (χ^2=5.852, df=1, p=0.016) and sourdough breads (χ^2=20.948, df=1, p=0.000) and their intention to purchase products made from heritage grains. H16 hypothesis was accepted. Accordingly, it can be said that those who consume heritage breads, pseudocereal breads and sourdough breads consider purchasing products made from heritage grains more than those who do not. A statistically significant relationship was found between the preference of heritage breads (χ^2=4.085, df=1, p=0.043) and sourdough breads (χ^2=20.714, df=1, p=0.000) and the consumers' belief that easier access to products made from heritage grains would increase their consumption frequency. H17 hypothesis was accepted. Those who consume heritage breads think that easier access to products made from heritage grains increases their consumption frequency compared to those who do not consume them, and similarly, those who consume sourdough breads think that easier access to products made from heritage grains increases their consumption frequency compared to those who do not consume them. A statistically significant relationship was found between consumers' preferences for heritage breads (χ^2=22.914, df=1, p=0.000) and sourdough breads (χ^2=20.787, df=1, p=0.000) and their willingness to pay more for products based on heritage grains. H18 hypothesis was accepted. It can be said that those who consume heritage breads want to pay more for products based on heritage grains than those who do not, and similarly, those who consume sourdough breads want to pay more for products based on heritage grains than those who do not. A statistically significant relationship was found between consumers' preferences for heritage breads (χ^2=4.767, df=1, p=0.029), pseudocereal berads (χ^2=7.521, df=1, p=0.006) and sourdough breads (χ^2=26.655, df=1, p=0.000) and their belief that sourdough breads are healthier than commercial breads. H19 hypothesis was accepted. Those who consume heritage breads, pseudocereal breads and sourdough breads know that sourdough breads are healthier than commercial breads compared to those who do not. A statistically significant relationship was found between consumers' preference for sourdough breads and their belief that the healthier sourdough breads will increase the amount of consumption (χ^2=3.904, df=1, p=0.048). H20 hypothesis was accepted. It can be said that those who consume sourdough bread think that the healthier sourdough breads increase its consumption compared to those who do not. A statistically significant relationship (χ^2=6.755, df=1, p=0.009) was determined between consumers' preference for sourdough bread and their belief that easier access to sourdough breads will increase the frequency of consumption. H21 hypothesis was accepted. Those who

consume sourdough bread think that easier access to sourdough breads will increase the frequency of consumption compared to those who do not. A statistically significant relationship was determined between consumers' preferences for heritage breads (χ^2=14.709, df=1, p=0.000) and sourdough breads (χ^2=29.576, df=1, p=0.000) and their willingness to pay more for sourdough breads. H22 hypothesis was accepted. Those who consume heritage breads are willing to pay more for sourdough breads than those who do not consume them, and similarly, those who consume sourdough breads are willing to pay more for sourdough breads than those who do not consume them.

4 DISCUSSIONS

In the study, all hypotheses were accepted except for H9 hypothesis. Considering these results, consumers' bread consumption frequency, knowledge and preferences (Fig. 1-3), it can be concluded that healthy nutrition is important for people, but the level of healthier (qualified) bread consumption is not sufficient. The fact that people have a low desire to make bread at home (Table 2, 3-maybe 12% and most likely 5.3%) makes it more important for people to buy healthier bread. People prefer to buy bread from the bakery (3-24.3% and 4-27.7%) instead of the market (3-7%, 2 and 4-10.1%). It was determined that people may consider purchasing bread and bakery products made from ancestral grains (Table 3) (%83.4, H5, H16 supported), that easier access will increase the frequency of consumption (%80.2, H6, H17 supported) and that they are willing to pay more for these products (%65.1, H7, H18 supported). The awareness that sourdough breads (Table 4) are healthier (%84.1, H8, H19 supported), that easier access will increase the frequency of consumption (%82.2, H10, H21 supported) and that they are willing to pay more for sourdough products (%69.9, H11, H22 supported) prove that people's tendency towards healthy bread and bakery products is constantly increasing.

In questions related to qualified bread preferences, that is, in all hypotheses (except H9), a statistically significant relationship was found. While bread preferences are more important for women than men (H1, H12 supported), it was found to be more important for people aged 25-35, 36-45, 46-55 (H2, H13 supported), and it was determined that it became more important for people as the level of education increases (bachelor's, master's, and doctorate education) (H3, H14 supported). For people with middle-upper income levels (1300-1799 USD), the quality of bread was more important

(H4, H15 supported). In the shopping done by couples together, women are more dominant in food preferences, and women are more effective in the preference of cereals and breads in food distribution (Loginova and Mann, 2024). The enrichment of the composition of bread, its fiber or the tendency to consume whole wheat bread are preferred by people with higher income and higher education (Jezewska-Zychowicz and Królak, 2020). It has also been assumed that people with very high-income levels rarely consume bread and that bread consumption is limited. It is known that bread consumption in people's daily diet decreases with increasing socio-economic level and income (Sadowski *et al*., 2024). In addition, it is noteworthy that the consumption of traditional and industrial breads is quite high in the study (Fig 3) and that the people who consume other breads are the ones with primary and secondary education and low-income people (0-440 USD) who prefer them the most. It is widely known in the world that people with low-income levels consume more bread (Sadowski *et al*., 2024). In his thesis study, Alkan (2019) stated that people in the middle age (40-54) and older age (>54) range and those with higher education levels prefer sourdough breads, while he stated that income level does not have a significant relationship with consumption. It was claimed that sourdough breads do not make a difference because they have been widely consumed in Turkey for a long time (Alkan 2019). In this study, a statistically significant relationship was determined between education level, gender and income level and especially sourdough bread preference. The reason for this is that the majority of people in Turkey have been consuming bread produced with baker's yeast for the last 30-50 years, and after realizing the importance of natural and traditional breads in terms of health, there has been a significant tendency towards healthy nutrition. People's awareness of nutrition or the nutritional education they receive can affect the amount of bread consumed and the type of bread. It is also stated that people need to be better motivated and sufficiently educated when consuming bakery products (Jezewska-Zychowicz and Królak, 2020). Many factors, including bread price, demographic characteristics, eating habits and education on human nutrition, determine the type and amount of bread consumed (Sadowski *et al*., 2024)

In Turkey (Gaziantep province, Turkey's first UNESCO-registered gastronomy city), sourdough whole wheat bread (79.52%) was determined as the most consumed bakery product, followed by sourdough rye bread (30%) and sourdough einkorn bread (29.05%) (Alkan 2019). Bread consumption preferences in Turkey are changing towards

qualified breads such as whole wheat bread and rye bread (Cobanoglu *et al*., 2022). Rye and wheat flour are the most preferred in the production of sourdough breads in many countries around the world (Badem, 2023; Siepmann *et al*., 2018). When consumers make their bread choices, factors such as bread having good taste and aroma, artisan production in small businesses, having a healthier composition, and appealing to a conscious consumer are important (Wang *et al*., 2024). In addition, the consumption of local grains and supporting their production are also at the forefront. Studies have determined that awareness-raising efforts have been carried out to increase the varieties of local wheat and their consumption, and that this has been successful. However, the high cost of bread made from local wheat varieties has been shown to be the biggest obstacle to their preservation (Yıldız and Özkaya, 2024).

In Turkey, 11.6% of arable land is used for the cultivation of heirloom grains (especially emmer and einkorn) (Oehen *et al*., 2016). The bread and bakery products market are growing worldwide and the bread and bakery products market in Turkey is also expected to grow by 5.3% in 2026 (STATISTA, 2025). In developed countries, bread consumption shows a decreasing trend (Sadowski *et al*., 2024). In studies conducted in Turkey, similar to the general literature, a decrease in bread consumption is observed. In addition, it has been observed that consumers' education level, occupation, household size and monthly income, their willingness to pay higher prices for whole wheat bread varieties (Akdemir *et al*., 2020), and the increase in income and education levels and the level of awareness about health and quality of life have changed attitudes and perceptions regarding bread varieties and the amount consumed. In addition, it has been determined that there has been a significant decrease in consumers' bread consumption level and a change in the place where they buy bread. People's bread consumption preferences have changed due to factors such as a healthy life and the desire to consume quality bread, low-calorie diet, changing living and working conditions, and women's greater participation in business life Cobanoglu *et al*., 2022). The knowledge about the importance of bread for health and the ease of online services and easier access to bread varieties with the support of digital technologies are increasing the demand for organic and traditional whole grain bread and cereal products, and this trend is encouraging local farmers to turn to sustainable agriculture (STATISTA, 2025; Longin and Würschum, 2016).

Sourdough products appear to be organoleptically, and nutritionally acceptable and new gluten-free products can be developed (Fekri *et al*., 2024). It shows that

sourdough can be used with ancient grains in the production of bakery products such as bread, pastry, cooked grains, porridge, snacks, muffins and cookies (Jönsson *et al*., 2025; Škrobot *et al*., 2025; Maravić *et al*., 2024; Roumia *et al*, 2023; Tomić *et al*., 2023). It is understood from many studies that ancient grains can be used to produce products with characteristics that are acceptable to consumers (Zamaratskaia *et al*., 2021).

In the study, it is observed that the young people (25-35 and 36-45 age groups) are more inclined to qualified breads, and that healthy nutrition awareness is increasing, that the diet is starting to change, that people with an increasing level of wealth are turning to healthier breads, and that criteria such as bread prices are being given less importance. This situation requires the use of commonly consumed breads such as loaves of bread and bakery products with sourdough and preferably ancient grains in the production in order to positively affect public health, especially in the Turkish society that consumes a lot of bread. Guiné *et al*., (2016), in a study conducted in Portugal, found that nutrient-rich breads are preferred especially by women and people with higher education. Wendin *et al*., (2020) drew attention to the fact that the potential of heritage grains should be turned into an advantage, that commonly produced bakery products should be reformulated in this context and that bread and bakery products should be produced healthier with rich taste and aroma. It is stated that the new generation should be guided in this direction, especially with effective new communication tools such as social media, and that food markets should be shaped accordingly (STATISTA, 2025; Longin and Würschum, 2016). t is noteworthy that bread and cereal products have a 14.98% share in the world market (STATISTA, 2025). Therefore, heritage grains and sourdough products should be redesigned and marketed as artisan products, taking into account their support for local production, sustainability and ecological impact (Mucha, 2024).

5 CONCLUSIONS

Bread is one of the most widely consumed foods in the world. Although bread consumption in developed countries is decreasing, the consumption of bakery products continues to increase in the world. Therefore, bread has important effects on people's nutrition. This study evaluated people's attitudes and preferences regarding bread consumption. As in the rest of the world, in Turkey, people's tendency towards healthy food and quality bread has increased in parallel with the increase in healthy nutrition

awareness. The study determined that people's socio-demographic characteristics and the amount of bread consumed, and the type of bread are substantially affected. While the preference for making bread at home was higher before, the tendency to buy all kinds of food has increased with developing technology, strong communication networks and widespread logistics networks. In line with people's demand for healthy nutrition, the variety of traditionally produced breads (artisan breads produced using ancient-heritage grains and sourdough) continues to increase all over the world, its preference is increasing day by day. People’s knowledge that sourdough breads and breads made from heritage grains are healthy and that they can be more easily accessed continues to increase their preference. In general, it has been observed that people have a more positive approach to consuming quality breads. As a result, people are even willing to pay more to buy qualified bread. This situation provides the food industry with the opportunity to produce more diverse and healthy heritage grains and sourdough products, as well as turning the negative effects of ultra-processed foods containing food additives into an opportunity.

It has been determined that the tendency towards healthy (qualified) breads among consumers is higher in women, middle-aged people (36-45 and 46-55), people with a bachelor's degree and above, and people with a middle-upper income level (1300-1799 USD). The most well-known grain among ancient-heritage grains is einkorn wheat, the most consumed qualified bread is sourdough bread, while among other breads, loaf bread is the most consumed bread type. Similar to data from other countries, bread preferences of people with low incomes are indicated in favour of other breads that are cheaper, widely produced industrially (first among which is loaf bread). Sociological characteristics such as people's eating habits, education in nutrition, bread prices, and welfare level have been determinants of bread consumption.

Turkey's unique characteristics (geographical location, plant diversity, being the homeland of many plants such as wheat and barley, cultural richness from history, advanced culinary culture, food diversity, etc.) should encourage more consumption of its ancient grains and sourdough breads to protect public health, and the production of new products should be encouraged by sharing information with other countries. The advantage of being in a central location between Europe and Asia, close to many developed and developing countries in the world, should be utilized. More importance should be given to ancestral grains in order to ensure biodiversity and sustainability.

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Competing interests

The author declares no competing interests.

Ethical approval

All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional research committee by the Social and Human Sciences Scientific Research and Publication Ethics Board approved on 21.11.2024. The survey only started after the ethical approval.

Informed consent

The survey was conducted face-by-face, where the introductory text of the questionnaire informed participants about: the scientific purpose of the research, only adults can fill in the questionnaire, their participation is completely voluntary, their answers are anonymous, and their identity cannot be identified.

Artificial Intelligence (AI) usage

No assistance was received from artificial intelligence (AI) in the preparation and writing of this article.

Authors' Contribution

The first and corresponding author (as a single author) wrote all the content and conducted all analyses presented in this article. The single author conducted the entire study, including conceptualization, data acquisition for analysis, methodology, data analysis, and validation, interpretation, article drafting, revising, final submission, and approval, and is responsible for the accuracy and integrity of this work.

Data availability

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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