QUALITY ATTRIBUTES AND FOOD WASTE IN APPLE VALUE CHAIN: A CONSUMER PERSPECTIVE

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Abstract

Fruticulture is one of the main sub-sectors of Albanian agriculture, the production of which is mainly dominated by apples. Despite the development trend of the last years, actors in the Apple supply chain are facing various issues, leading to product loss and waste within the chain. This derives due to problems related to the quality of seedlings, the varietal structure, low level of technology, the lack of storage capacities, lack of labor force, etc., but also as a consequence of consumer's perception and knowledge related to the attributes of fruit quality. Although losses are higher at the bottom part of the value chain, the waste generated at the consumption level (consumers) cannot be neglected either.

The study aims to identify the factors that influence the behavior of consumers in the market, analyzing the characteristics that contribute to food quality. According to the nature of the study and the data type, the quantitative research method was determined as the most appropriate for addressing the research findings. Through primary research instruments (structured questionnaires), 286 consumers were interviewed in the retail market in the city of Korça. In addition, the collected data were processed and analyzed through the SPSS program. Accordingly, consumers evaluated the qualities related to sensory, safety, and aesthetic features, (appearance and color) as the most important.

To reduce the level of waste, concrete actions are needed from all the stakeholders, encouraging not only the cooperation between actors of the food chain but also increasing the awareness of consumers as important contributors to the reduction of waste.

Keywords: apple production, supply chain, quality attributes, stakeholders, Korça.

1. Introduction

In Albania, the fruit sector is one of the main contributors in terms of farmers' generated income. Fruits cover 8% of the total amount of exports in the agri-food sector (UNSTAT, 2022). In 2022, fruit trees occupied around 23.7% (20,900 ha) of the permanent crop's total area, sharing 41.1% of the total production. The highest level of fruit production was reached in the Korca region (82,900 tons). Fruit production structure is composed mainly of apples (35.1%), plums (15.3%), cherries (8.2%), and peaches (7.6%), with 63% of the total apple production produced in Korça (INSTAT, 2023). The two Red Delicious derivatives that are most widely produced are Red Chief and Starking and Golden Delicious. Other apple varieties grown include Fuji, Granny Smith, Mutzo, Idared, etc. This region has become a leader in apple production due to its suitable land and climate conditions, as well as its technical expertise. In 2021, the average yearly consumption of fruit per person in Albania was 206.81 kg, while the average yearly consumption of apples was 36.2 kg, compared to 11.5 kg globally and 18.77 kg in Europe (Our World in Data).

Table 1. Fruit and apple consumption per capita

Country	Fruit consumption (kg)	Apple consumption (kg)
World	86.4	11.51
Europe	103.17	18.77
Albania	**206.81**	**36.08**

Data source: UN Food and Agriculture Organization (Our world in data)

Despite the development trends of the last decade, a higher level of productivity and competitiveness in the domestic and international markets should be attained. The sustainable development of the sector is highly dependent on the level of technology, knowledge, and inputs that directly affect farm performance (Marku *et al*, 2017).

Food loss and waste have become one of the major challenges affecting the sustainability of food systems and therefore decreasing food availability, creating vast food security, economic, and environmental issues. Globally, almost 1/3 of the food produced for consumption purposes (approximately 1.3 billion tonnes per year) is lost or wasted (FAO, 2011a). Depending on the type of commodity, current estimates place food loss at 14% and waste at 17% of total production (FAO, 2019; United Nations Environment Programme, 2021). A significant amount of food waste that is dumped in landfills is converted into greenhouse gases (GHGs) and methane, which has the potential to cause 25 times more global warming than carbon dioxide (Parry *et al*, 2007). Several authors provide the differences between food loss and waste, arguing that the distinction between these concepts relies on the stages where loss or waste occurs. Food waste is primarily produced during retail and final consumption, whereas loss occurs during the production, postharvest, and processing phases of the food supply chain (FAO 2019; Delgado et al, 2021). The term "food waste" is used more for behavioral problems, while understanding why consumer's waste food is very complex and critical to identifying effective ways of reduction (Parfitt *et al*, 2010). Table 2 shows the quantity that is lost or wasted in the fruit and apple supply chain through poor handling, spoiling, lack of refrigeration, and damage from the field to retail. The data indicate that the quantity of fruits that are lost in Albania (11.91 kg) is higher than the world average (9.42 kg) and twice the European average (5.75 kg).

Table 2. The quantity lost/wasted in the fruit and apple supply chain

Country	Per capita fruit waste in supply chains (consumer waste not included) in kg	Per capita apple waste in supply chains (consumer waste not included) in kg
World	9.42	1.04
Europe	5.75	1.31
Albania	**11.91**	**3.85**

Data source: UN Food and Agriculture Organization (FAO)

While food losses occur frequently in developing countries during the early stages of the supply chain, food surplus and waste are more common in developed nations during the later stages of the chain (FAO, 2011). Most studies examine the impacts of food loss in the early stages of the chain, while in many of them, food waste is not taken into account at all (Ceruti *et al*, 2014). The reasons why consumers waste food are diverse and complex, but understanding them is critical to identifying effective ways to reduce food waste (National Academies of Sciences, Engineering, and Medicine, 2020). Quality perception and preferences significantly impact consumers' decisions about the food they buy and consume. Their preferences are influenced not only by their psychological state but also by the intrinsic and extrinsic characteristics of apples. Because fruits offer less extrinsic quality cues (no packaging), consumers take shape and other appearance cues as indicators for intrinsic quality (Grunert *et al*, 2004).

Various authors have explored the quality traits of fruits. Skreli and Imami, (2012), found out that origin, variety, and size are quite important attributes when analyzing consumer preferences for apple attributes, while other studies investigated the marginal values consumers place on apple quality cues, revealing that size, color, and sensory attributes (flavor, sweetness, and crispness) are important factors that influence their decision to buy apples (Carillo *et al*, 2013; Bonany *et al*, 2013). In addition, Combris *et al*, (2009) found out that consumers are not willing to compromise taste characteristics for food safety. Eriksson et al. (2012), argue that for fresh produce especially in fruit and vegetable production, aesthetic standards can lead to pre-store

losses, while further waste may occur as produce deteriorates in-store, becoming unappealing to consumers (Cicatiello *et al*, 2016). Consequently, food waste may result from products that are not purchased or consumed.

The study examines the factors influencing consumer behavior in the market from the perspective of quality attributes and addresses the issue of consumer waste at the point of purchase for apples. Moreover, identifying the quality attributes that mostly affect consumers' purchasing decisions and lead to waste can help supply chain actors and the government take action to reduce food waste.

2. Methodology

Based on the study objectives, quantitative research was deemed the most suitable approach. The study involved systematic data collection to investigate the main factors influencing consumer behavior regarding the quality attributes of apples, using descriptive research analysis.

Primary data was collected through a structured questionnaire consisting of 18 questions divided into two sections. A total of 286 questionnaires were distributed in the wholesale and retail market in the city of Korça through face-to-face interviews. The research is conducted in this region due to its status as the primary producer of apples and well-educated consumers regarding quality attributes. Before the interview, the consumers were informed on the purpose, reason, and importance of the study, as well as the ethical considerations, such as preserving anonymity, privacy, and non-prejudice of their answers. The technique used for selecting the study population is a voluntary probability sample. Only consumers willing to participate in the survey and possessing the required characteristics were interviewed. In the initial section of the questionnaire, participants were required to provide demographic details such as age, gender, education level, income, and family size.

In the subsequent part of the survey, participants were asked to specify the frequency of their apple consumption and to evaluate the quality characteristics of apples that most significantly impact their purchasing choices. These attributes were rated on a scale from 1 to 5. To ensure a diverse range of consumer perspectives in the study, the sample was diversified based on the age categories, as outlined in table 3.

Table 3. Consumers age groups

Age category	Less than 30 years
	31 – 44 years
	45 – 65 years
	Older than 65 years

Source: Author's Professional paper

To increase the reliability and validity of the research instruments, the questionnaire was tested before distributing it to a larger consumer population. The collected data were processed and analyzed through the SPSS program.

3. Results

3.1 Challenges of the apple value chain in Albania: Throughout its journey, from the farm level to the consumer, there are a set of processes, operations and actors of the food chain that influence the end use of an apple. As such, apple producers in Albania and other actors in the supply chain face a set of challenges that enhance the level of loss and waste. In the context of Albanian agriculture, recent developments have brought attention to structural challenges within the fruit value chain. Issues related to poor information and financial flow between

producers and other chain actors have made farmers vulnerable in terms of business performance. Additionally, the need for storage facilities to ensure year-round apple availability is hindered by insufficient storage capacities, impacting the quality, market prices and the competitiveness of the sector in the region. The lack of proper storage infrastructure, such as cold storage and silos, is causing post-harvest losses as apples deteriorate. Other challenges persisting include concerns about varietal structure, where market demand shifts towards new varieties, the use of low-quality seedlings, and the impact of farm size on competitiveness. The small size of farm is a significant obstacle to the development of the apple sector, as it increases the cost of production and diminish the opportunities for new investments. In addition, limited market access, low level of technology investments and support, high prices of inputs, and lack of labor force due to out-migration and displacement of young people towards urban areas, complete the spectrum of issues that the fruticulture sector is facing. Furthermore, in the retail and consumer stages, waste occurs due to inefficient logistics, aesthetic standards at retail, and consumer perception in terms of quality attributes. However, the quality of apples is distorted throughout all stages of the supply chain, and farmers play a significant role as they determine the quality standards that buyers mostly want (Mattsson, 2014). Given the challenges related to loss and waste, more actions are needed by various actors across the chain.

3.2 Consumer Perception Toward Apple Quality Attributes: Before assessing the quality attributes of apples influencing consumer's buying habits, the consumption patterns across different age groups were investigated. The results show that apple consumption varies significantly across different age groups, with middle-aged and older consumers prioritizing daily apple consumption more than younger consumers.

**Table 4**. Evidence on consumption patterns of the respondents (n=286)

Age category	Everyday	A few times a week	A few times a month	Very rare	Never
Younger than 30 years (n=32)	18.6%	64.3%	10.7%	6.4%	-
31 – 44 years (n=71)	35.6%	47.3%	11.5%	5.6%	-
45 – 65 years (n=138)	58.6	31.7	7.4	2.3	-
Older than 65 years (n=45)	59.4	36.1	3.3	1.2	-

Source: Author's publication

According to the information provided in table 4, it is confirmed a tendency of lower apple intake among younger consumers, with only 18.6% consuming apples daily and 64.3% a few times a week. The term "food waste" is typically associated with issues related to behavior during retail and final consumption (The Government Office for Science, 2011a;). In the Korca region, there is significant variation in the efficiency of apple farms about production costs (Minga and Marku, 2023). Thus, improving the efficiency of the food supply chain could lead to lower food prices for consumers and increased access to food.

Consumers' expectations are influenced by quality traits, which can be either intrinsic or extrinsic. When consumers' expectations (expected quality) do not match with the experienced quality, it leads to lower levels of satisfaction and creating the premises for increased food waste, worsening the scarcity of natural resources, increasing greenhouse gas emissions, and impacting the economic and environmental dimensions of sustainability. In this section are reported the findings examining consumers' preferences in terms of fruit quality attributes as an important aspect for diminishing the level of waste. Consumers in the studied area were asked to rank the importance of apple quality attributes at the points of purchase and providing

their opinions ranking the quality attributes in a rank order from 1 to 5. Accordingly, sensory traits appeared to have an important role in consumer decisions when buying apples in the market.
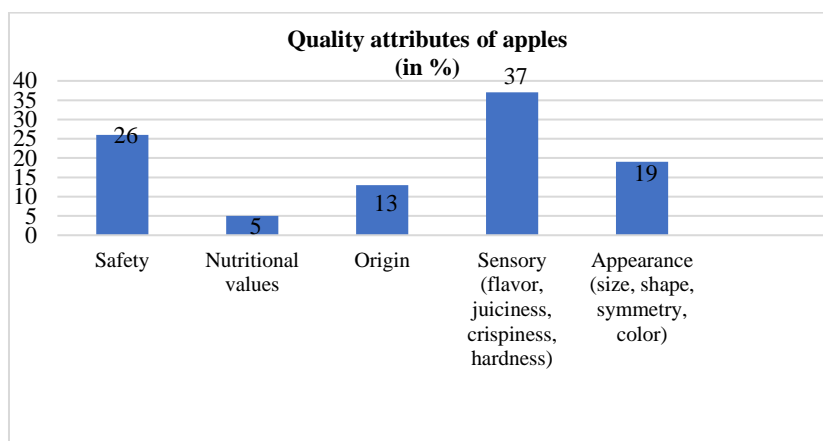
Figure 1. Assessment of Apple Quality Attributes
Source: Author's publication

The frequency of responses as provided in Figure 1 indicates that consumer perception and buying habits for apples are heavily influenced by sensory attributes (37%), safety (26%), and appearance (19%) at the point of purchase. The results are similar to findings in other studies (Aschemann, 2015; Lombart *et al*, 2019), emphasizing the high level of perfection of sensory attributes as being even more important than safety when consuming apples. Additionally, consumers were asked to describe the perfect apple according to sensory and appearance quality attributes. Slocombe *et al*, (2016), define flavor as the combination of perceived sensations in the oral cavity (sweetness, tartness, and bitterness) along with the aroma that is perceived via retro-nasal transfer. The survey findings showed that when consumers search for the "perfect apple" they mostly prioritize juiciness (34%) and appearance (24%) as the main factors of their preferences, figure 2.
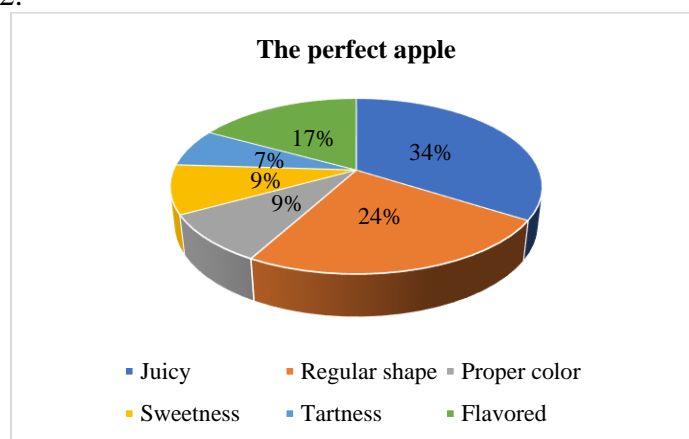
Figure 2. The "perfect apple" according to consumer preferences
Source: Author's publication

Regardless the ranking that consumers placed on the sensory and appearance attributes, it is evident that retailers and consumers are used to seeing only uniform and nearly perfect fruits. As a result, misshapen apples may be left in the field, even though they are just as nutritious as the more uniform ones. This deprives consumers who may not require perfectly shaped fruits of the opportunity to consume them, leading to unnecessary waste.

4. Conclusions

The study highlighted that loss and waste in the apple supply chain can occur at various stages and involve all the actors. Problems at one stage can have a widespread impact throughout the entire chain. Consumers often have to make trade-offs between convenience and aesthetics when choosing food. The desire for perfect sensory and appearance quality leads consumers to discard fruits that don't meet their standards. The study found that sensory attributes, safety, and appearance significantly influence consumers' perceptions and purchasing habits. This means that apples not meeting aesthetic standards may be rejected by retailers and consumers, leading to waste. The study also pointed out that consumers are unwilling to purchase misshapen fruits despite their nutritional value. It is important to create awareness and programs on the importance of reducing waste across the supply chain and conducting consumer education campaigns to emphasize that even imperfect fruits have the same nutritional values and safety standards as regular-shaped ones.

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