Proceeding Paper

Farm-to-Fork SMART LABEL for Increasing Consumer Trust and Ensuring Support for Local Milk and Dairy Producers [†]

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Abstract: The COVID pandemic has modified the consumer perception towards food, more and more attention being given to natural and local ingredients, with low or no preservatives added and raw or poorly processed products, as a way to support good immunity. In an extremely globalized economy where food value chains are frequently long and complicated, consumers discover there is a gap between the level of information they necessitate from animal products in order to make an informed purchase decision. As consumer tastes and environmental challenges evolve, the industry becomes ever more diverse and resourceful. Today's consumer is more interested in the raw materials used to obtain the processed products, final product freshness and quality, sustainability, authenticity, transportation, shelf life, and even how recyclable the packaging is. SMART LABELS have been used successfully by big food companies, but their use in the traditional agri-food production system is relatively unknown. Their use may boost the demand for milk and dairy products produced locally or regionally by sharing information about the dairy product value chain during the life-cycle of the product, nutritional specifications, health-oriented attributes and even recipes in which the product may be used. The aim of the present study was to asses weather the use of smart labels (quick response codes and thermochromic indicator) may increase consumer trust towards locally produced animal origin products, while facilitating the development of an interactive connection between consumers and local producers, where consumers are able to give feedback, ask questions and contribute actively to the development of other the products and services.

Keywords: food chains; smart labels; food safety; local producers; dairy products

1. Introduction

Dairy products are one of the world's most popular food groups, comprising a wide range of processed milk derived from animals such as cattle, goats, sheep, camels, and buffaloes, as well as milk-based products such as yogurt, cheese, butter, and ice cream. With milk being the third most produced agro-food, the worldwide dairy sector was estimated at over $400 billion, accounting for around 14% of global agricultural commerce [1]. However, restrictions and lockdowns imposed throughout the world due have impacted global supply networks.

The COVID pandemic has modified the consumer perception towards food, more and more attention being given to natural and local ingredients, with low or no preservatives added and raw or poorly processed products, as a way to support good immunity [2]. In a highly globalized world, where food value chains are often long and complicated, consumers find there is a gap betwIn an extremely globalized economy where food value chains are frequently long and complicated, consumers discover there is a gap

between the level of information they necessitate from animal products in order to make an informed purchase decision. As consumer tastes and environmental challenges evolve, the industry becomes ever more diverse and resourceful. Today's consumer is more interested in the raw materials used to obtain the processed products, final product freshness and quality, sustainability, authenticity, transportation, shelf life, and even how recyclable the packaging is [3–7].

SMART LABELS have been used successfully by big food companies, but their use in the traditional agri-food production system is relatively unknown [7–9]. Their use may boost the demand for milk and dairy products produced locally or regionally by sharing information about the dairy product value chain during the life-cycle of the product, nutritional specifications, health-oriented attributes and even recipes in which the product may be used.

Consumer attitudes toward, and acceptance of, technology development and their applications are crucial elements in their successful adoption and commercialization. This is especially true in the food business, where customer concerns about the health impact, traceability, authenticity, and safety of food products are becoming increasingly evident. Customers who receive product information through the use of "smart labels", including the farms in which the primary matter (milk) is produced, nutritional benefits of dairy products, and the potential contribution of thermochromic labels to increase local food security may have a higher acceptance rating and be willing to pay more for locally produced products. For producers', technology guarantees operational traceability and manufacturing process control, from start to end, as well as allowing for personalized digital promotions [11,12].

The aim of the present study was to asses weather the use of smart labels (quick response codes and thermochromic indicator) may increase consumer trust towards locally produced animal origin products, while facilitating the development of an interactive connection between consumers and local producers, where consumers are able to give feedback, ask questions and contribute actively to the development of other the products and services.

2. Material and Methods

The surveys were conducted on consumers residing in the north-east region of Romania, from March 2021 to June 2021 using electronic questionnaires (TypeForm) that assessed consumers' perception relating to food labels, respectively the use of QR codes and thermochromic labels for traditional dairy food produced locally such as yoghurt, kefir and hard cheese. The concept of thermochromic indicator and its function was explained to the respondents before applying the questionnaire. In the first survey, 208 respondents were included, of whom 63% were female and 37% male, with age ranging from 18 to 65 years old.

Questions relating to food labels and perception regarding local produced products were developed by the investigators (Figure 1) and the respondents were invited to complete online the answers. Basic information regarding the respondents such as age, sex, area of residence, level of studies was accounted for.
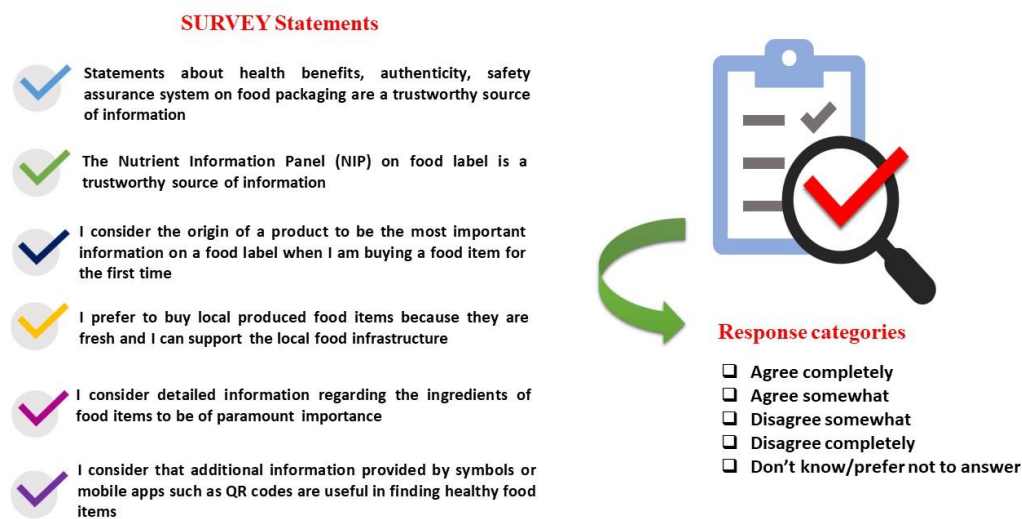
Figure 1. Survey statements and answers relating to food labels.

To assess the perception of respondents regarding the use of QR codes and thermochromic labels for traditional dairy food produced locally such as yoghurt, kefir and hard cheese, a separate survey was carried out on a smaller size group in which were included persons that declared to have used or scanned previously QR codes. For each assessed item, scores from 1–5 were attributed, where 1 represented less usefulness and 5 high usefulness regarding the transmitted information through the proposed tool, respectively QR code and thermochromic indicator (Figure 2). The data retrieved and processed in the Microsoft Excel statistical package.

Figure 2. Survey regarding consumer attitude regarding the level of importance of information that may be transmitted using QR codes and Thermochromic labels.

3. Results and Discussions

The demographic characteristics of the survey respondents are presented in Figure 3. Almost two thirds of the respondents from were female (68.5%). The 18–25-year age group, respectively 55–65-year age group were the smallest, accounting for 14.5% and

3.5% of the survey sample, respectively. Almost 2 thirds of the respondents were in the age category 25–34-year (31%), respectively 35–45-years (38%) (Figure 3). Over 85% of the respondents declared to be living in the urban or metropolitan area (suburban). In the analyzed group, 72% of the respondents declared to have a Bachelor's or Advanced Degree, 18% declared to have completed High School, 10% to be completed some form of college. Almost half of the total respondents declared to have an average medium net income (Figure 3).
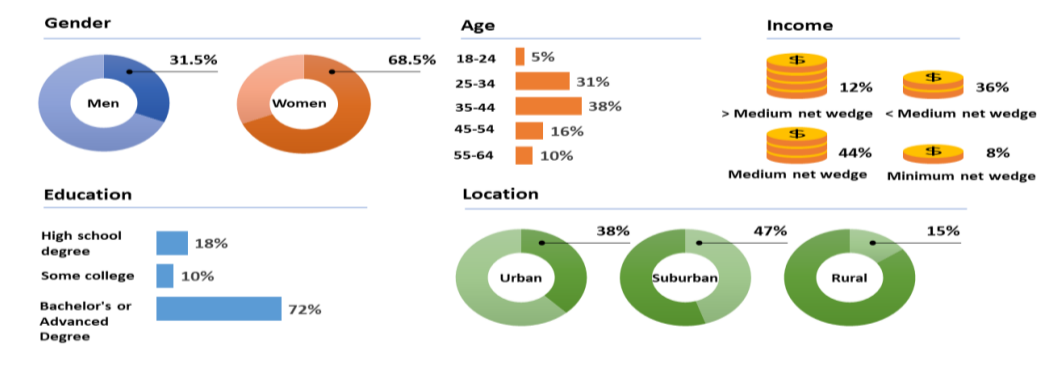

Figure 3. Demographic characteristics of the survey respondents.

For the first survey, the response rate (questioners completed) was 90.38%. The response to the statements formulated are presented in the below figures.

The majority of the respondents agreed completely that the Nutrient Information Panel offers trustworthy information regarding the food, while some of the respondents (21.28%), declared to disagree somewhat regarding the degree of trust they have in statements about health benefits, authenticity and safety assurance system present on food packing (Figure 4). Nearly 45% of the respondents declared that they prefer to purchase local food items to beneficiate from fresh products and support the local food infrastructure. The responses to the statements about aspects of food packaging that may guide their purchase of a food products for the first time, over 30% of the respondents considered origin to be the most important information on a food label (Figure 5).
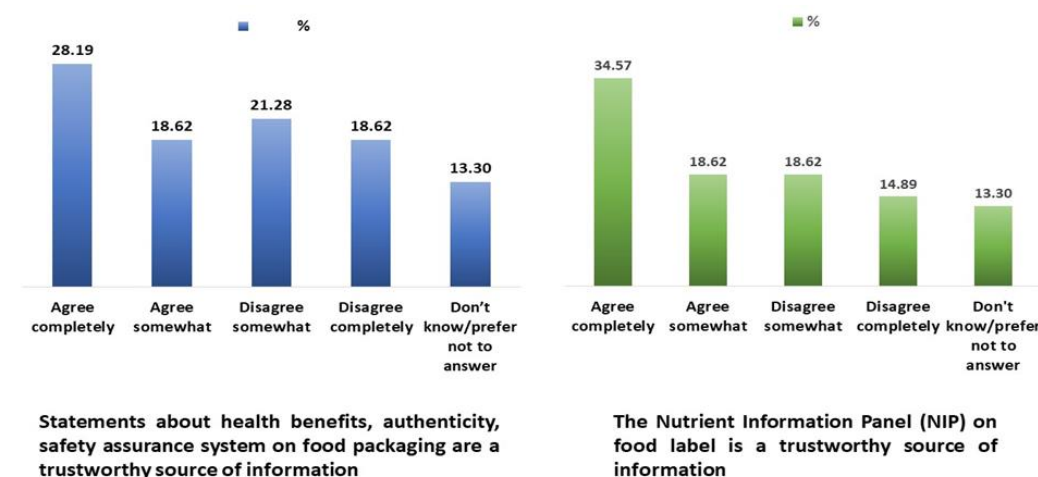

Figure 4. Formulated statements regarding the packing and Nutrient information Panel and responses of the respondents.
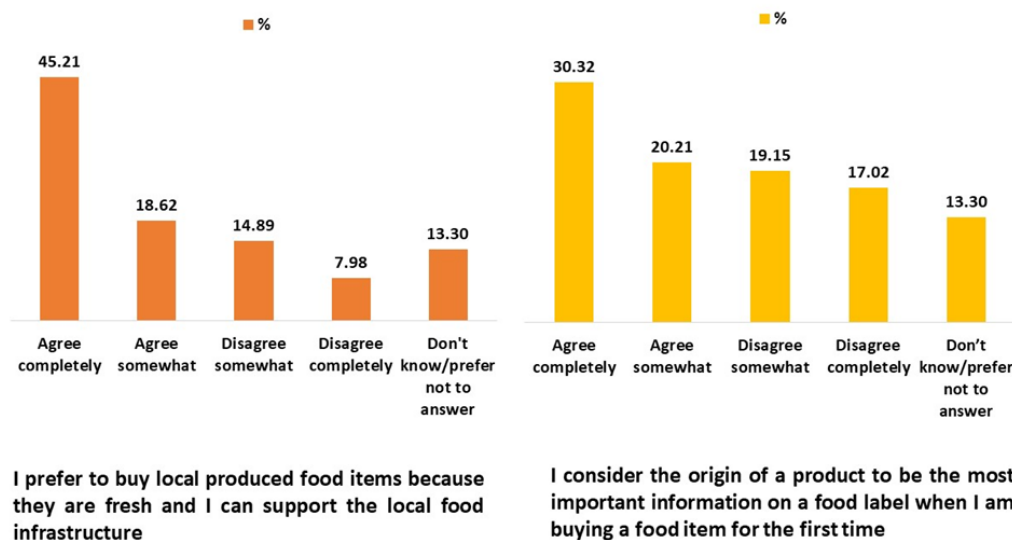
Figure 5. Formulated statements regarding the origin of products and factors that may influence the purchase.

Over half of the respondents considered that details regarding the ingredients of food items are of paramount importance, while 33.22% considered that additional information provided by symbols or mobile apps may be useful in finding health food items (Figure 6).
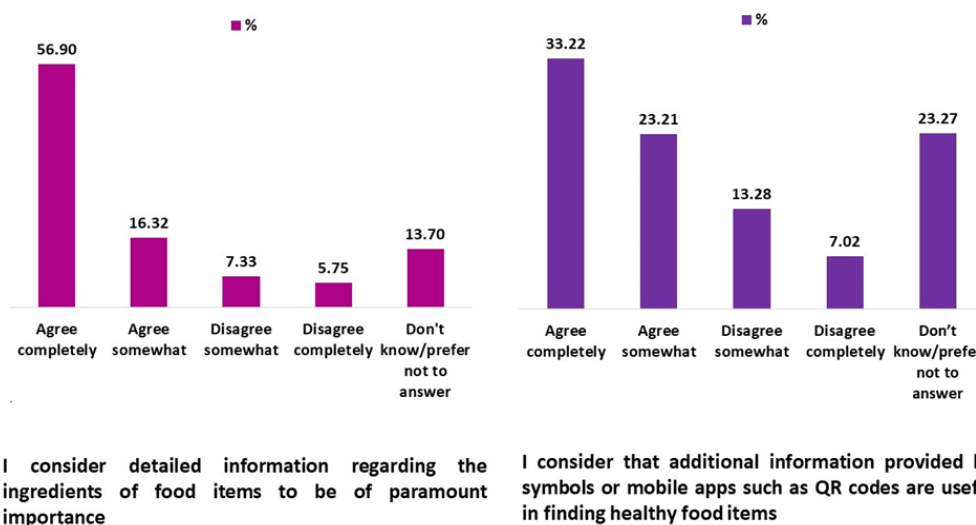

Figure 6. Formulated statements regarding the nutritional information and the utility of QR codes in finding healthy food items.

In the second survey, the sample consists of 108 respondents, of whom 63% were female and 37% male. In terms of age distribution, the younger generation, ages 18–24 (39.1 percent), and those aged 25–34 (39.1 percent), had the highest proportion of responses (37.2%). Given that QR code is a relatively new concept and represents a kind of innovation in the food business, the research findings are consistent with the hypothesis that the majority of QR code users are younger in age. In the analyzed group, 87.7 percent of respondents stated to have a higher degree of education (Bachelor's or Advanced Degree), while 12.3 percent stated to have a secondary degree. This larger percentage of higher educational profile respondents shows that the younger population, with higher educational degrees are more attracted to technological innovations and trends. The re-

sults of the survey on consumer perception regarding the usefulness of the information transmitted through SMART Labels, under the form of quick response codes (QR), thermochromic indicator for monitoring temperature and freshness indicator are presented in Table 1.

Table 1. Respondents' ratings of "SMART LABELS" with QR code and thermochromic indicator.

Assessed Item	Consumer Attitudes Mean Score
Nutritional properties of dairy products	4.11
Detailed information on local milk producers and manufacturers, images from farms and production process	4.09
Information regarding the traceability of the dairy products (Transportation and preservation conditions)	3.77
Information regarding the authenticity and quality control of the dairy products (authenticity and quality certificates)	4.45
Temperature monitoring system under the form of a thermochromic indicator	4. 25
Link that directly connects dairy manufacturers with consumers for getting more information, offering feedback, comments, suggestions	4.07
Recipes for dishes and desserts using locally produced dairy products	2.11
The recycling potential of the package used	3.35

Information regarding the authenticity and quality of locally produced dairy products was rated with a mean score of 4.45 while the information on nutritional properties of dairy products was rated with the mean score of 4.11. The respondents consider this information to be a desirable addition in the QR code placed on locally produced dairy products. The presence of detailed information regarding local milk producers and manufacturers, images from farms as extra information in the QR code of dairy products received a mean score of 4.09 from respondents. The results indicate that this information regarding the producers, manufacturers, as well as images from farms are meaningful for consumers.

One of the most important aspects of food safety is maintaining the proper handling and storage temperature of food products. Within the last 20 years, food safety has been a hot subject in the food business, food policy, and scientific research. Consumer concern about food safety has grown in recent decades, prompting governments throughout the world to step up their efforts to enhance food safety [13,14]. Every day, people consume foods on the assumption that they are manufactured, processed, transported, and kept in compliance with quality standards and safety standards. However, data reveal that every year, over 600 million people throughout the world get infected with illnesses as a result of ingesting contaminated food products, with over 40,000 lives being each year [14]. Dairy products are one of the most widely consumed food groups on the planet. Despite the fact that dairy products are essential for the nutrition and health of people of all ages, especially those who are particularly vulnerable to health problems, such as babies and the elderly, quality has been a big issue for the dairy industry [15].

Unsurprisingly, in our study the respondents considered very important the information regarding the temperature monitoring system, under the form of a thermochromic indicator (score 4.25), as well the information regarding the traceability of the dairy products (transportation and preservation conditions) (score 3.77), but the higher rating score was attributed to the information regarding the authenticity and quality of the dairy products, which was considered to be the most important (score 4.85).

Respondents also considered important being able to offer their feedback, comments, and suggestions through a link that directly connects them with the dairy manufacturers. The environmental impact of food products is gaining more and more attention, todays' consumers being more and more preoccupied by the recycling potential of the materials used for packing. In the present study, the information regarding the recycling potential of the package used was rated with 3.35. Information regarding recipes for dishes and desserts using locally produced dairy products was considered less meaningful by respondents', the rating score being 2.11. This suggests that consumers are more interested in the quality of the dairy products, their authenticity and nutritional content, and the farms in which the milk is produced.

The competitive retail food landscape is rapidly evolving, and there are two major factors driving this shift: a dynamic customer who is bringing new purchase decision triggers to the market, and an evolving market marketplace that is imposing new pressures on conventional grocery retailers. The modernizing customer, mostly inspired by millennial (ages 18–35) tendencies, is searching for more information about the items it purchases. Consumers, in particular, are seeking for more transparency in the food manufacturing process. Because of the evolving competitive landscape, retailers must change their approach from an operations-driven to a consumer-driven philosophy. Food may now be acquired through any channel of distribution, necessitating more participation in the shopping experience by traditional grocery shops to meet customer requirements. This involves informing customers about the origins of the food they buy. This degree of transparency as well as other useful information may be provided to customers via QR codes [16,17].

4. Conclusions

Smart labels may increase consumer trust towards locally produced animal origin products, by offering information about the food value chain, quality or authenticity of the locally produced products. This approach may also facilitate consumers and local producers to create an interactive connection, where consumers are able to give feedback, ask questions and contribute actively to the development of other the products and services. Furthermore, growing consumer interest in local animal products may help reduce the environmental footprint by shortening the distance between farmers and consumers as a result of shifting consumer preferences. The support given to the community producers will strengthened the local food infrastructure, generate more jobs, while the population will have access to healthy and fresh products.

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