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Original article

Consumer Behaviour toward Food Labels and its Implication on Food Waste during COVID-19 Crisis in Tunisia

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Abstract

The coronavirus (COVID-19) outbreak affected the whole world at different scales: politically, economically, and socially, including compromising food security. All over the world people experienced significant changes contributing to different reactions and attitudes: fear, anxiety, depression... Therefore, this pandemic has altered their behaviour. This research aimed to evaluate to which extent crisis situation, like COVID-19 pandemic, would affect consumers interest to food labels, and the consequences on food waste. An online survey of 295 Tunisian consumers was conducted three months after COVID-19 lockdown. The survey collected information on demographic data, extent of household food waste, use and knowledge of food labelling information and food waste assessment. The pandemic situation enhanced consumers' interests to labels, as 61% of respondents stated to pay great attention to labels and to always check them. Elderly and university educated respondents are the most sensitive people to labels, in a COVID-19 context. Regarding understanding food labels, particularly date labels, Tunisian consumers still have some ambiguity as 33% could not provide correct answers about date labels definitions, which may lead to food spoilage and misuse. Interestingly, most of respondents declared to waste a low amount of food on post Covid-19 period. Their judgment in discarding a food product was based mostly on food storage considerations than on the use of date labels. These findings indicate the need of more effective communication about food labels, particularly date labels, in order to contribute in reducing household food waste, and potentially improving food security.

Keywords: Covid-19, Consumer behaviour , Food waste, Food label, Survey

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INTRODUCTION

Consumers' behaviour evolved significantly during the last decades. Consumers' are more aware about the importance of their safety and diet's link with health statues. This fact could be manifested through food purchasing. For example, information on food products related to quality, health and environment gained a huge importance (Petrescu et al., 2020). Packaging represents the first contact with products. Several definitions were suggested for packaging (Wyrwa and Barska, 2017). It could be considered as "a physical structure suitable for a product, which is designed to protect it from damage and deterioration. Packaging enables also dividing products into portions and transport (utility functions). Moreove, it provides information on the product and present it aesthetically (promotional functions)" (Wyrwa and Barska, 2017). Particularly, Food labels play a key role as vehicle of many informations. In fact, a label "means any tag, brand, mark, pictorial or other descriptive matter, written, printed, stencilled, marked, embossed or impressed on, or attached to, a container of food" (CODEX STAN 1-1985). In this context, food labels could be considered as a marketing tool for manufacturer ensuring communication function. The communicated information would be the main factor determining the food purchasing act. Labelling includes "any written printed or graphic matter that is present on the label, accompanies the food, or is displayed near the food, including that for the purpose of promoting its sale or disposal" (CODEX STAN 1-1985). In general terms, information should mention not only the shelf-life of the product and nutritional value, but also ways of preparation, consumption, or other commercial aspects (Wyrwa and Barska, 2017). Therefore, labels are important for purchasing of food products: They may emphasize product quality and nutritional criteria. Furthermore, they ensure food safety. This could be the case of instructions for use, storage conditions and/or conditions for use and indications related to durability. In case of date marking of foods, many dates could be presented: Date of Manufacture (the date on which the food becomes the product as described), Date of Packaging *(*the date on which the food is placed in the immediate container in which it will be ultimately sold), Sell-by-Date (the last date of offer for sale to the consumer after which there remains a reasonable storage period in the home), Date of Minimum Durability or Best Before (the date which signifies the end of the period under any stated storage conditions during which the product will remain fully marketable and will retain any specific qualities for which tacit or express claims have been made. However, beyond the date the food may still be perfectly satisfactory), Use-by Date (the date which signifies the end of the estimated period under any stated storage conditions, after which the product probably will not have the quality attributes normally expected by the consumer. After this date the food should not be regarded as marketable (CODEX STAN 1-1985). The numerous date labels may confuse consumers. Taking into account that consumers are looking for safety, they would prefer eating fresh products without toxicity risks (Fortin et al, 2009). Thus, understanding date label is capital. One manifestation of label date misunderstood would be throwing products that could be used (Newsome et al, 2014; Kavanaugh and Quinlan, 2020), and therefore enhancing food waste.

Food waste is a matter of global concern. It has reached alarming proportions these past decades: according to the Food and Agriculture Organization (FAO, 2011), one third of all food produced in the world is wasted every year. In addition to being a problem of great ethical significance, food waste addresses food security as well as economic, environmental and social issues. Although food waste occurs at different points ~~of~~ in the supply chain, over 50% of food waste occurs at the household level (Stenmarck et al, 2016). In Near East and North Africa region, food waste was evaluated at about 250 Kg per year per individual and, at the consumption stage, to be 34% (FAO, 2015). In the Arab world, Abiad and Meho (2018) have reported a variation of food waste generated at the household level from one country to another. According to Tunisian National Institute for Consumption (INC, 2017), the most wasted food products are bread (16%), cereals products (10%) and vegetables (6%). These wasted foods could potentially feed those in need and thereby contribute to enhancing food security (Bachta, 2011). Household food waste can be influenced by several factors, like shopping behaviour and household management practices, as well as psycho-social factors (Aschemann-Witzel et al, 2015; Falasconi et al, 2019; Farr-Wharton et al, 2014; Jörissen et al, 2015; Preka et al, 2020; Yildirim et al, 2016). For example, in UK, "not used in time" led to throwing about 50% of avoidable food and drinks (WRAP, 2013). In the same context, according to a Swedish household diary study, 20 to 25% of food was wasted because of packaging factors like best-before date passing (Aschemann-Witzel et al, 2015).

The coronavirus (COVID-19) marked the beginning of 2020 (WHO, 2020). At the beginning of the pandemic, to control the spread of the virus many countries opted for the lockdown strategy. As COVID-19 spreads and has affected the entire food system, concerns for food security and nutrition started to rise (FAO, 2020). Such situation may have a significant psychological impact on consumers. Wang et al. (2020) have pointed out that the COVID-19 outbreak has had psychological impact, leading to anxiety, depression, and stress among Chinese respondents. Stressful situation may cause changes in living habits affecting consumers' behaviour (Durante, 2016). Covid-19 pandemic, induced changes in consumers shopping behaviours and spending (Chronopoulos et al, 2020; Li et al, 2020). Interestingly, this pandemic situation contributed in decreasing food waste (Jribi et al, 2020; Pappalardo et al, 2020). Household food waste can be considered as an indicator of the reduction in food consumption as well as in disposable income, impairing food security of Tunisians (15.2% of poverty) (OCDE, 2019). In order to meet the United Nations sustainable development goal (SDG) 12, in particular the objective to halve per-capita food waste at the consumer level by 2030, it is important to understand factors leading to such behaviour. Decisions to discard food items are mainly related to food safety (Van Boxstael et al, 2014). People use different strategies, when they have doubts about food safety or when products have expired (Stancu and Lähteenmäki, 2018). Sassi et al. (2016) have pointed out a good understanding of food labels by Tunisian survey respondents, related to the high education level of the sample. To date, the previous studies have dealing with food date label understanding and food waste behaviours were conducted in common situation. Hence, the aim of this research was to assess to which extent crisis

situation like COVID-19 would affect consumers interest in food labels, and implications of such behaviour on food wastage. In this study special focus has been given to consumers' demographic characteristics.

MATERIALS and METHODS

This research consisted on an online survey research. The questionnaire was based on previous study of Jribi et al. (2020).

Data collection and analysis

The survey was carried out through a self-administered questionnaire in French language (the academic language in Tunisia) from September 28 until October 11, 2020, three months after the end of COVID-19 lockdown, through the Google website (www.google.com). The survey aimed similarly to assess respondents understanding of food labels and food waste. The questionnaire consisted of 12 questions varied between one option and multiple choice and structured in 4 sections: (1) Extent of household food waste; (2) Use and knowledge of food labelling information and (3) Food waste assessment. The last part was about socio-demographic characteristics (gender, age, number of persons in the household, education, employment). Respondents were recruited on a voluntary basis. Pupils and students living at their parents' place and not contributing actively to the household life were excluded from this study. The survey was disseminated through various institutional communication channels, such as institutional website, social media (https://www.facebook.com/) and by mailing. Internet use increased between 15 and 20% in Tunisia during the lockdown phase (National Telecommunications Authority,2020). Moreover, the choice of this particular social media was justified by its high penetration rate in Tunisia (7.3 million of users out 11.7 million of inhabitants) (National Telecommunications Authority,2020).

Data analysis consisted in frequency counts and percentages, using Microsoft Excel software. On a second step, Chi-square tests of independence were used to test for associations with demographic variables, using GraphPad Prism (version 8, 2019). Statistical significance was determined by $p<0.05$.

Socio-demographics of respondents

As shown on Table 1, our sample was not gender balanced as women represent 67% of total respondents. The over representation of women in voluntary food related surveys is an often observed phenomenon (Sassi et al, 2016). Such findings would be also expected as more women than men shop for groceries (Fortin et al, 2009). Therefore, women would be more willing to answering such surveys. Mostly, young persons (62% under 40 years old) with high education level participated on this survey. This fact could be related to the way the research was conducted (a questionnaire administrated via internet and in French) and also the willingness of people with higher education to participate on surveys (Fortin et al, 2009).

Consequently, the respondents' sample was not representative of the Tunisian adult population since the non-probabilistic sampling design was used. However, it could be considered as representative within the aforementioned groups (Abeliotis et al, 2014). In order to further improve the panel's representativeness, survey weights were applied and used in all Chi-square analyses (Neff et al, 2015).

RESULTS and DISCUSSION

Interrelations between Consumers Characteristics and Food Labels

Food labels are indicators of the product's overall quality (Grunert et al, 2001). They list information including a description of the food, the net weight, the ingredients list, best before or use-by dates, storage and preparation directions, as well as warnings about ingredients known to cause allergic reactions. Respondents were asked about their reading and understanding of labels of food packages (Table 2).

Table 1. Respondents' socio-demographic profile (n=295)

	% of respondents
Gender	
Women	67
Men	33
Age (years old)	
18 – 25	11
26 – 40	51
41 – 59	30
60 and more	8
Number of persons in the household	
1	7
2	17
3	24
4 and more	52
Education	
Primary and high schools	15
University	85
Occupation	
Farmers	2
Craftsmen, traders, entrepreneurs	12
Managers and higher intellectual professions	44
Intermediate professions	2
Employees	17
Workers	1
Retired	6
Students	11
Other people without activity	7

Results showed that most of the respondents paid great attention to food labels (containing the ingredients list, date label, nutrition label if present).In fact, 61% of respondents declared to check food labels always and 35% did it often. Our results indicate a widespread practice of reading the food label. They are in accordance with results of Jribi et al. (2020) showing a better shopping performance of consumers during the initial stage of COVID-19 lockdown. When compared with the study of Tunisian Ministry of Trade (2004), there was a decrease from 10% to 4% of respondents that never reads at the food labels. Not reading could be explained by lack of time or concerns about the accuracy of the information, and could also be related to consumption habits and past positive experiences (Aygen, 2012). In fact the attention to food labels is related to the purpose of the task. For instance, date labels give information related to food product safety (Štefanić, 2018). Jeddi and Zaiem (2010) have identified labelling as a solution of reassurance for the consumer. The potential perceived risk leads to the use of the label for information purposes to reduce this risk (Larceneux, 2004). Consumers seek for information to comfort them and to help them make the right choice. In fact this information is intended to contribute to informed food purchase decisions and uses, which are particularly sensitive in a COVID-19 context (Drichoutis et al, 2005). These decisions are crucial in this context, since they are related to the quality and safety of food products. Moreover, food labels can help consumers for a more consistent storage of purchased food items, in order to keep them fresher for longer. Because of COVID-19, grocery shopping frequency has decreased (Jribi et al, 2020) and some edible food items such fruits and vegetables were not always available in the grocery stores. The use of food labels was significantly associated with sex, age and education ($p<0.05$). Our data are in accordance with those of Jeddi and Zaiem (2010), Aygen (2012), Besler et al. (2012) showing that women, elderly and university educated respondents are the most sensitive people to labels. They would probably pay more attention to their safety, diet and nutritional status in particular during the COVID-19 pandemic.

More respondents reported that they pay often attention to the ingredient list on food packaging (45%), than always (29%). These findings are consistent with those of Song et al. (2015). This mandatory ingredients list contains the ingredients quantity in descending order of predominance and weight of each component ~~ingredients~~. It also provides information on components quality and the presence of additives. According to respondents, reasons for not reading ingredient list included lack of time, size of print on packages, and lack of understanding of technical terms. There is actually an increasing trend among consumers for more "natural" food products and concerns over food additives (E ou SIN-numbers) (Evans et al, 2010). Consumers assume products based on natural ingredients without additives as healthier. Therefore they tend to actively interrogate ingredients lists to seek for food product "naturalness" and to facilitate avoiding products containing contraindicated additives (Cheung et al, 2016). The past years have seen an increasing use of mobile phone applications scanning products in order to find out information on additives and then to help consumers on their product choice (Tekiano, 2013). About 730 products are available on "Open Food Facts Tunisia". The attention to the

ingredient list was significantly associated with sex, age and education ($p<0.05$, Table 2). Probably because of their awareness of the health-diet relationship, women, elderly and university educated respondents read more frequently food ingredient list of food packaging, than others, particularly in a COVID-19 context.

Regarding attention to nutrition labels and claims, 65% of respondents declared to read them, when they are available. Nutrition labelling is part of a strategy to improve the nutritional health of a population (Cowburn and Stockley, 2005). Consumers are aware of the relationship between diet and health, through good nutrition (Jarraya et al, 2010). The strong link between nutrition and immunity, and the risk and severity of infections have been well established (Chandra, 1996). For instance immune cell functions can be improved by the consumption of various dietary vitamins, minerals antioxidants as well as prebiotics and probiotics, and their impact on protection against infectious microorganisms have been well studied (Puertollano et al, 2011). To the best of our knowledge, no specific dietary factors have been identified for reducing risk of acute infections like COVID-19 (Barazzoni et al. 2020). Besides being physically active, managing stress, and getting enough sleep, consuming good quality diets is critical to strengthen the immune system (Ministry of Public Health, 2020). The high proportion of people reading nutritional labelling found in this study is in accordance with previous studies (Benajiba et al, 2019; Besler et al, 2012; Drichoutis et al, 2005; Prieto-Castillo et al, 2015; Stranierri et al, 2010). According to Tunisian regulation, nutrient declaration is mandatory only for foods in question of nutrition claims, meaning that it is optional for all other foods (JORT, 2008). However Tunisian food manufacturers start to put basic nutrition labels on packages, including caloric value and contents in lipids, carbohydrates and proteins, for assisting trade and guiding consumers (Benajiba et al, 2019; Štefanić, 2018). This can help consumers to decide the overall healthiness of a product (Benajiba et al. 2019; Cowburn and Stockley 2005). Mobile applications such "Open Food Facts Tunisia" can also help consumers by providing a "Nutri-Score" logo: this logo indicates the nutritional quality of food products with A to E grades. Because of the COVID-19 context, consumers were more interested in keeping their diet balanced and in improving their immunity, and more likely to use food nutrition labels as an aid-instrument leading their decisions in food and beverage selection. The respondent's frequency of nutrition label reading was significantly increased with respondent's age, probably because of their higher health concern during the COVID-19 pandemic, than other age groups (Tek and Karaçil-Ermumcu, 2018).

Since food labels constitute the only source of information available to the consumer at the point of purchase, it was important to determine whether respondents are able to understand this information to guide their food selection. Interestingly, most of them affirmed to understand fully (53%) and at least partially (45%) food labels. Using the food label information suppose that consumers can find them, look at and read, and understand them, in order to make decisions to choose food products adapted to

time of crisis like COVID-19. Among the misunderstanding reasons of food labels, some respondents declared that they found them incomprehensive, unclear and/or difficult to use. For manufacturers, food labels on packages aim in meeting legal requirements and in supporting marketing communication, rather in providing aid to consumers (Štefanić, 2018). This level of understanding was significantly associated to age and education ($p<0.05$).

Related to the understanding of the date labels, 60% of the respondents claimed to know the difference between the labels use by and best before. Similar findings were found by Van Boxstael et al. (2014) and Preka et al. (2020). Only 67% of respondents have knowledge about the use-by label (by giving the correct answer). False answers on "used by" were statements related to "best before" label, meaning that there still have some ambiguity in food labelling subject. Our findings were in line with those of previous survey research of Kavanaugh and Quinlan (2020) where 57.4% of respondents correctly identified "best by, use by". In WRAP (2011) study, around half of British consumers could correctly identify the best before date as a quality guideline and the use by date as a safety indicator. The understanding on date labels was significantly associated with sex and age ($p<0.05$). Our results are lower than those found in North Africa region, by Abouabdillah et al. (2015), Sassi et al. (2016), and Arous et al. (2017) stating that most of survey respondents have a good understanding of "use by" food date label. This discrepancy was related to the high education level of their survey samples (95%). This confusion in date labelling shown in our study can lead to a decrease in the odds that food items are fully utilized (Neff et al, 2019). Manufacturers put "best if used by" to indicate best quality/taste dates, and for perishable foods, "use by" to give the date after which the food should be discarded. Interestingly 28% of respondents consider that the food is still safe to eat after the "use by" date if it is not damaged or spoiled. Similarly Neff et al. (2015) have indicated that 72% of American survey respondents relied on judgement to decide to discard milk. According to WRAP (2011), more than 85% of British consumers use their sensorial abilities to decide whether or not to eat fresh produce rather than a date. This behaviour leads to a food safety risk and to a potential food poisoning (Wilcock et al, 2004). There is actually a debate about these date labels. According to WRAP (2017), a third of household food wastage could be attributed to consumer misunderstanding of the date label. There is then an increasing amount of research studying the relationship between date labelling and food wastage, and how date labelling can be improved (Neff et al, 2019; Van Boxstael et al, 2014; WRAP, 2017).

All together, our results suggest that consumers have incorporated the labelling information into their food purchase habits. In this situation, decisions to choose more nutritious and/or less harmful food products potentially have important implications for consumer health improvement. They are based on food labels understanding. However less than half of the respondents declared not or partially understand all the information included in food labelling. This can lead to a misuse of these food products

Table 2. Self reported measurement of food labels attention and understanding before or during purchasing, by demographics

% respondents	All	Gender		Age (years old)				Education	
		Women	Men	18 - 25	26 - 40	41 - 59	60 and more	School	University
Food labels reading									
Yes	61	66	49	61	63	56	78	60	89
Often	35	31	43	36	34	40	11	36	11
No	4	2	8	3	3	5	6	4	0
Chi square (df)		8.054 (2)		23.03 (6)				22.94 (2)	
P value		0.0178*		0.0008*				<0.0001*	
Ingredients list reading									
Always	28	30	22	21	39	31	22	0	30
Often	45	47	37	44	40	55	56	60	44
Rarely	19	18	26	26	16	7	11	20	19
Never	7	5	15	8	6	7	11	20	7
Chi square (df)		8.876 (3)		26.75 (9)				38.75 (3)	
P value		0.0310*		0.0015*				<0.0001*	
Nutrition messages and claims reading									
Yes	65	66	64	63	65	67	100	63	73
No	35	34	36	37	35	33	0	35	27
Chi square (df)		0.08791 (1)		47.87 (3)				1.748 (1)	
P value		0.7668		<0.0001*				0.1862	
Understanding food labels									
Yes	53	55	48	49	60	43	61	70	52
Partially	45	43	49	46	40	53	39	30	45
No	2	2	3	5	1	5	0	0	3
Chi square (df)		1.067 (2)		14.64 (6)				8.656 (2)	
P value		0.5865		0.0233*				0.0132*	
Knowledge of date labels									
Correct answer	67	61	81	53	70	68	67	70	67
False answer	33	39	19	47	30	32	33	30	33
Chi square (df)		9.713 (1)		7.905 (3)				0.2086 (1)	
P value		0.0018*		0.0480*				0.6479	

[a]The results are expressed as the percentage of respondents

*p<0.05: for each Chi square test, the percentages shown represent column proportions

Interrelations between Consumers characteristics, Food Labels and Food Wasting Assessment

Several factors can intervene in consumers' judgment in discarding a food product. Most of them are related to food safety. From a list with pre-defined categories (WRAP, 2011), the respondents were asked about the criteria they rely on to make the decisions to discard a food product, one single answer was allowed (Table 3).

Most of respondents (70%) declared to decide to discard a food product based on how long it was stored. Evaluating the storage conditions, followed by checking the used-by date of a food product, were also criteria given by, respectively 11% and 7% of respondents for throwing away food products. A minority of consumers report using perceptions of the food such as bad appearance, aroma and flavour for assessing food edibility. This study indicates that the use of storage considerations was the most common reported driver given for discarding food items. In contrast, WRAP (2011) has indicated that the use of sensory judgement was the most common reported driver given for discarding food, followed by storage time considerations. Food products past their prime often constitute a substrate for the proliferation of any microorganisms (molds, bacteria, yeasts) present, increasing then the risk of food-borne illness. According to Redmond and Griffith (2003), consumers have a high level of concern about food safety issues and reported positive food safety beliefs and food safety self-efficacy. Relationships have been established between food safety knowledge, attitude and practices among consumers (Wilcock et al, 2004). According to Patil et al. (2005) consumers think themselves to be adequately informed regarding food safety, and they are aware of some safe food-handling practices. For instance they try to implement safe food storage management to reduce the risk of food-borne illness. In our study, respondents judge to discard food products if they were no longer good (70%) or inadequately stored (11%), in accordance with Romani et al. (2018). The impact of storage temperature and duration on growth of food-borne microorganisms and therefore edibility has been extensively studied. Our findings pointed out a lack of food storage skills. That is particularly true with high turnover foods, discarded because forgotten. Similarly Farr-Wharton et al. (2014) have shown that a majority of consumers fail to use storing strategies to increase food longevity in their households. Although negative changes in texture, color, odour and taste of spoiled *food can constitute good indicators of food safety for the consumers, using sensory judgment was the least cited approach for making the decision to discard in our study. Meanwhile, previous results (Jribi et al. 2020) showed that during Covid-19 lockdown only 40% of respondent are using shopping list. Consequently, they might buy items they still have. This fact, together with inappropriate storing conditions might lead to spoilage of these products*. Only 7% of respondents based their judgement on food date labelling. The use of date label was much lower than those observed in studies of WRAP (2011), Van Boxstael et al. (2014) and Neff et al. (2019). This can be related to confusion about different kinds of labels (Abeliotis et al, 2014; Yildirim et al,

2016; WRAP 2011), although 66% of respondents were knowledgeable on use-by date. Food storage management can influence the intensity of waste behaviour (Farr-Wharton et al, 2014; Setti et al, 2016). Kantor et al. (1997) have shown that household waste was partially due to expired foods, forgotten in storage.

The decision for food wastage based on criteria (storage time and conditions, expiration date, tasting, appearance and smelling) was significantly dependent on gender, age and education ($p<0.05$; Table-3). Related to gender, checking of the storage time was more common for women than for men (79% versus 53%). Based on their senses, men tend to observe and smell, whereas women tend to taste. According to WRAP (2011), women tend to "use their own judgement" about when to eat or throw away foods, more than men. Interestingly, men checked date labels more than women (16% versus 2%). These data are in contrast with results of Van Boxstael et al. (2014) and Neff et al. (2019). This might be related to the fact that men are more knowledgeable on date labels than women in our study. Elderly use date labels more than respondents under 60 year, but they declared to not rely on sensory judgment when compared to other age groups. Similar findings were observed by WRAP (2011), and Van Boxstael et al. (2014). Neff et al. (2019) have suggested differing perceptions of food safety threat by age. According to Abbot et al. (2009), young were poorly engaged in recommended safe food-handling practices and were knowledgeable in only two-thirds of the food safety items. Elderly have probably set up a more structured and orderly storage system (Farr-Wharton et al, 2014). In relation with education, university educated respondents declared to make their decisions based on the storage time (70% versus 52% of respondents with lower education), and date labels (70% versus 52% of respondents with lower education). Neff et al. (2019) have established a relationship between education and date label understanding.

The criteria-based decision making was also significantly associated to self reported reading and understanding of food labels, whereas no significant association was found with date label knowledge (Table 3). Respondents who declared read and understand food labels were those using them. This positive correlation between knowledge and actual behaviour was logically expected. However only 7% of respondents declared to use date labels for make a decision, whereas 61% and 51% claimed to respectively read and understand food labels, and 63% were knowledgeable. This raises questions about the interface between understanding and interpretation of date labels. According to Redmond and Griffith (2003), the acquisition of knowledge alone is not enough to lead to the corresponding behaviour, or to appropriate changes in behaviour. *In a context of crisis like COVID-19 pandemic, a significant* psychological impact occurs as showed by results of Wang et al. (2020). Thus, in such circumstances of anxiety and stress, consumers are looking for new information related to the pandemic rather than expanding their knowledge about food labelling particularly that some of them declare understanding

the different labels while concretely it is not the case. As safety is an important matter in this context, consumers might throw away products that have just reached best to use date to avoid any risk.

Table 3. Interrelations between respondents' demographics, food labelling and criteria-based decision making to discard food

% respondents		**Criteria-Based Decision Making to discard food**						
		Too long storage time	Poor storage condition	Expired date	Poor sensory quality	Bad aspect, odour or taste	Chi square (df)	P value
All		70	11	7	6	6		
Gender	Women	79	7	2	8	4	23.51 (4)	0.0001*
	Men	53	18	16	4	8		
Age	18-25	84	0	5	5	5		
	26-40	65	13	8	8	5	35.35	
	41-59	70	11	5	5	8	(12)	0.0004*
	60 and more	75	13	13	0	0		
Education	Schools	70	10	7	7	6	13.13 (4)	0.0106*
	University	52	12	18	3	15		
Food label reading	Yes	67	11	7	8	6	50.66	
	Often	73	12	8	4	4	(8)	<0.0001*
	No	75	0	0	0	25		
Self reported date label understanding	Yes	73	10	10	2	6	38.38 (8)	<0.0001*
	Partial	66	12	5	12	4		
	No	50	17	0	17	17		
Knowledge of date label	Correct	70	5	10	8	8		
	False	66	14	7	6	6	5.462 (4)	0.2431

[a]The results are expressed as the percentage of respondents

*p<0.05: for each Chi square test, the percentages shown represent row proportions

Findings of this research pointed out the need of informing and persuading consumers to adopt methods to better store and preserve food, since this was the most cited criteria for discarding food. Wilcock et al. (2004) have concluded the need for guidance for consumers regarding food safety issues. Moreover, it is useful to help consumers to establish an organised system of food storage in order to reduce waste production in households (Schanes et al, 2018). Our data also indicate that Tunisian consumers tend to not rely on date labels to make the decisions to throw away food, although 60% do understand them. This might be probably due to the fact that they would not know in practice how to handle product items correctly after they have passed their date.

Neff et al. (2015, 2019) have pointed out that the expiry date causes wastes due to consumers' hesitation about foods near their expiry date. Tunisian authorities do not provide an official advice about that topic. Canali et al. (2017) have recommended changing the labelling to "best before", “durable until” or "at least preservable until" to make it clearer to the customer that the product could be consumed also after this date. Additional research is needed to identify reasons other than knowledge that drive the safe behaviour of consumers, which can be helpful in developing food waste communication programs. *In time of crisis, safety issue was raised and consumers paid more attention to labelling. This would be interesting for potential communication strategies through labelling.*

Conclusion

This research tackled the issue of consumers' interest to food labels and its implication on food waste during a crisis context like COVID-19 pandemic. Results showed that in this crisis situation, respondents paid more attention to labels on products they bought as they care more about safety. This behaviour was strongly correlated with demographics as elderly and university educated respondents showed a higher awareness. *Meanwhile, understanding date label still challenging. In practice only a small minority of respondents tended to use date labels to decide whether they discard a food products, even though they understand date labelling. Knowledge alone does not seem enough. This study pointed out the need of knowledge on food storage, including what to do after opening a product. Among drivers of future possibilities of food waste reduction, providing information on more accurate labelling and guidance on domestic food storage practices can be helpful for consumers. Consequently, potential strategies may focus on communicating clearer messages through food labels as consumers are not efficiently using date labels, in some cases they are even misunderstanding them which may enhance food waste, and potentially food insecurity. Limitations of this study would be related to the unbalanced sample and the use of online self-administrated survey where answers could be over-estimated. Therefore, future studies should consider collecting data from multiple sources (face-to-face, diaries...) on different situations and crossing them.*

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