Evaluating Trends of Low Sodium Content in Food: The Willingness to Pay for Salt-Reduced Bread, A Case Study

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Abstract

High salt intake is an important health risk since its consumption is often strongly related to negative health effects. In light of this, and given the social and health costs linked to overconsumption of salt, this paper highlights the main factors related to the demand for foods that have a low sodium content. Our study aims to analyse in depth the preferences and attitudes of consumers towards food low in salt as well as assessing for the first time the willingness to pay (WTP) in order to determine whether consumers place a high value on sliced salt-reduced bread. The results show a fairly limited WTP for bread with a low sodium content, with the relevant values being calculated at 20% over the price of normal bread. This indicates that consumers are positively interested in this kind of product but their willingness to pay more is rather limited.The findings of this study also support an argument for the first time of the role played by the physical activity and physical characteristics of the sampled consumers, showing the importance of the body mass index in significantly influencing the individual WTP for low-salt bread.

Keywords: healthy food, food consumption, salt reduction, sliced bread

1. Introduction

Human eating habits have been modified deeply in recent decades by the strong growth in the awareness of a healthy diet and balanced nutrition. The relationship between food and health appears to be oriented towards a new equilibrium that takes more into account the need for compliance with certain nutritional thresholds in order to reduce dietary excesses (Di Vita et al., 2016a). Nevertheless, there are still many risks related to the overconsumption of certain nutrients that are potentially harmful to human health.

Following Paracelsus's famous statement: "the dose makes the poison", current stud-

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ies indicate that micro-nutrients, such as sodium, are not dangerous per se but their intake should take place according to the real needs of the human organism.

There are several researchers who have demonstrated that a high salt intake represents one of the most important risk factors for human health. High sodium intake is often strongly related to negative health effects such as rising blood pressure, hypertension, stroke, cardiovascular and coronary heart diseases (Strazzullo et al., 2009; Bibbins-Domingo et al., 2010; Liem et al., 2011, He et al., 2012), stomach and gastric cancer, asthma disorders and infections (Laatikainen et al., 2006). It is also strongly related to an increased risk of obesity (He et al., 2008) and pre-eclampsia during pregnancy (Duley and Henderson-Smart, 1999). Empirical evidence has pointed out the suitability, in terms of social costs, of reducing the consumption of salt, highlighting a favourable cost-benefit ratio (Selmer et al., 2000; Laatikainen et al., 2006; Cobiac et al., 2010; Mason et al., 2014).

A large number of recent studies on consumers has been directed towards food habits and dietetic products such as salt-reduced food. However, although there have been several empirical studies on consumption related to the functional attributes or additives in foods (Maynard and Franklin, 2003; Barreiro et al., 2008; Costanigro et al., 2014; D'Amico et al., 2016; Di Vita et al., 2016b), there are a scarcity of studies regarding consumer behavior towards dietetic food such as salt-reduced bread.

As argued in previous studies, the most relevant part of sodium intake comes from the salt used in processed foods, which provide approximately 70% to 80% of the total dietary salt intake (Mattes and Donnnelly, 1991; Grimes et al., 2008). Among the processed foods, baked goods, such as breads, cookies, and crackers, together with cured or processed meats, are the most consumed. Liem et al. (2011) estimated that cereals and bakery products represent the foods with the most relevant salt content in UK and USA diets as they comprise between 30% and 50% of the total sodium intake in those countries, while a recent study carried out in Italy observed that the consumption of cured meat, such as ham and salami, contributes over 15% of the daily dietary sodium consumption (ASSICA, 2012; Di Vita et al., 2017).

In this context, bread was considered the most suitable product for testing the hypothesis that there is a certain correlation between a positive willingness to pay (WTP) and healthy food.

Bread plays a very prominent role in the European countries diet and represent a key component of the European eating habits. Its consumption is relatively stable, with a tendency of a slight decrease in most countries (AIBI, 2013), such as in Italy, whereas despite bread consumption has experienced a continuous decrease, it is still a very important staple food in the Mediterranean diet.

In light of the importance that consumers place on the healthy attributes of food products and in order to test the specific consumers' requirements towards the low-sodium content of foods, this study presents the results of a preliminary and empirical analysis aimed at assessing consumers' WTP for bread with a low salt content.

The remainder of this paper is organized as follows. Section 2 provides a brief background of the existing scientific evidence and describes the main approach carried out by nutritionists and health economists on the role of sodium in the "lower-sodium foods issue". Sections 3 and 4 set out the econometric model used to assess the WTP through a contingent valuation and the methodology adopted to collect data and information on

the sampled consumers. Section 5 presents the results of our empirical analysis, which is focused on the main attitudes of a selected sample of Sicilian consumers towards a sliced low-salt bread and reports the main findings related to the WTP. Section 6 presents conclusions and discusses main findings.

2. Back ground: evidence on salt-reduction approach

The analysis of the overconsumption of salt can be viewed taking into account several perspectives. The "lower sodium foods issue" impacts human society in various forms given the deep differences in perceptions and priorities among the participants. These participants can be included in three different categories that behave in different ways with respect to the sodium content in food: 1) public and private health institutions; 2) food industry processors; and 3) consumers.

Government and public health institutions focus their attention on preventing the social risk sand diseases that are linked to the excessive intake of sodium. The social costs for the most developed countries from a high salt intake are very high (Asaria et al., 2007; Bochud et al., 2012; Bibbins-Domingo et al., 2010), but people are not always willing to pay an additional tax for salt-reduction program information (Kristiansen et al., 2006). Nevertheless, significant benefits to the population, both in economic and health terms, may arise from even a small decrease in sodium consumption (Palar and Sturm, 2009). Several policies have been formed to promote information campaigns that aim to change inappropriate food habits that encourage the onset of degenerative diseases of great epidemiological importance. The World Health Organization has highlighted the need to foster healthy life styles and eating and has pointed to the need for healthy food choices. The goal of *healthy* eating is to develop strategies that can help food consumers to address their eating patterns and make healthy food choices (WHO, 2007; WHO, 2012), but health benefits will take place only if consumers are able to make long-term changes in their eating habits and if salt reduced food becomes increasingly available (Sacks et al., 2001). With this aim, the European Parliament introduced specific measures to regulate and harmonize nutrition and health claims in all member states, thereby providing consumers with important informative tools on food content. The recent Regulation (EC) No. 1924/2006 indicates the conditions and the modalities that apply to nutrition claims, classifying them into several categories[1]. Amongst these categories a relevant role is stipulated for claims relating to low sodium/salt, very low sodium/salt, and sodium free or salt free. With regard to salt content, this regulation specifically stipulates that "claims that a food is low in sodium/salt may only be made where the product contains no more than 0.12 grams of sodium, or the equivalent value for salt, per 100 grams or per 100 ml", which represents on average less than the 25% of sodium that the normal product possesses.

With regard to food manufacturers and the food-processing industry, the initial resistance to the governments' recommendations for salt reduction (Godlee, 1996; Strazzullo et al., 2009) was later amended and recently many food producers and manufacturers

[1] These categories cover low energy, energy reduced, energy free, low fat, fat free, low saturated fat, saturated fatfree, low sugar, sugarfree, with no added sugar, low sodium/salt, very low sodium/salt, sodium free or salt free, source of fiber, high fiber, source of protein, high protein.

seem to have understood the importance of low-sodium products in food markets (Lucas et al., 2011) as a favourable economic opportunity for the food industry in terms of product differentiation. Although salt also affects the texture and preservation of food and its role is very important in processed meat, cheese, and baked goods production (Doyle and Glass, 2010), participants in the food industry are investigating ways to maintain the same perceived salt intensity at lower sodium levels (Dötsch et al., 2009).

Consumers are not always willing to consume lower-sodium foods if they do not really like them. Consumers' preferences are usually directed towards foods that stimulate their appetite and saltiness represents one of the most important flavor enhancers (Duley and Henderson-Smart, 1999; Liem et al., 2011).There is a potential consumer reluctance to buy salt-reduced products when they are used to consuming salty and palatable products (Doyle and Glass, 2010).

3. Econometric model (methodology)

In order to estimate the WTP of sampled consumers for salt-reduced bread we employed the contingent valuation (CV) method. According to previous literature (Alberini, 1995; Venkatachalam, 2004), the CV method is used in real scenarios where consumers are asked to declare their WTP for a certain good offered in a hypothetical (though realistic) market.

Through the CV method it is possible to measure individuals' WTP to increase either the quantity of a good and/or to reach improved qualitative features. In CV, individual WTP is estimated in a "contingent" way within a defined scenario. The estimation is based on a questionnaire survey, referendum, or auction. In the literature different techniques of elicitation have been suggested (Venkatachalam, 2004; Cameron and Quiggin, 1994; Carson et al., 1996). In this study the method of dichotomy choices used is the so called closed-ended method. It consists of an elicitation technique where bids are predetermined by means of an optimal bid design so that interviewees are asked to express their WTP a specific amount of money.

After collecting data an estimation of the WTP distribution is necessary. To this end a hypothesis on error distribution must be made. In our case study it was hypothesized as a logistic distribution. The logistic distribution is similar to a normal distribution but with a simpler shape to be treated analytically (Haab and McConnell, 2002). Moreover, in the univariate distribution, logit model conduct gives similar results to the probit model (Amemiya, 1985). In detail, the resulting logistic model is defined as:

$$\Pr ob(y_i = 1) = \frac{1}{1 + e^{-(\alpha - \beta \log BID + \beta' X_i)}}, \quad i = 1, 2, \ldots, n$$

Where y_i are a series of causal and binary independent variables that can assume two values: 0 and 1. It assumes value 1 when consumers accept the bid and assumes value 0 otherwise; X_i is a vector of explanatory variables with dimension (kx1); βis a parameter to estimate related to the bid (Amemiya, 1985).

4. Data collection

Our survey was carried out in Sicily and data were collected in order to obtain a representative sample of the regional consumers taking into account the metropolitan area

of Catania, which represents an interesting case study because its demographic features can be considered as representative of average Italian provinces.

The study was aimed at capturing the habits and socio-economic characteristics of consumers to identify the profile of consumers who buy bread daily and their WTP for salt-reduced bread. For this purpose a questionnaire was submitted using the face-to-face method to a random sample of 100 bread consumers; the interviews were held in July 2013. Consumers were intercepted at a large retail store and they were selected according to their willingness to cooperate with the survey (Di Vita et al., 2013; Panzone et al., 2016).

Table 1 *– Descriptive characteristics of the sample*

Variable	Description	Mean (% frequency)	St. Dev.	Min	Max
Gender	Sex of the respondents (Male = 1, 0 otherwise)	0.56	N.A	0	1
Male		56%			
Female		44%			
Age classes	Age of the respondents	40.9	12	19	72
18–30		(28.8%)			
31–45		(41.6%)			
46–60		(24.7%)			
>60		(7.9%)			
BMI	Body mass index	0,96	2.83	9.8	29.4
Underweight		9%			
Normal weight		77%			
Overweight		14%			
Physical Activity	1 if the respondents are regularly involved in physical activity, 0 otherwise	0.52	N/A	0	1
Education	Level of education				
Primary		(16.9%)			
Secondary		(46.1%)			
Graduate		(33.8%)			
Postgraduate		(3.4%)			
Income	Income per year				
<12,000 Euro		(9.0%)			
12–18,000 Euro		(28.1%)			
18–24,000 euro		(32.6%)			
24–36,000 euro		(12.4%)			
36–48,000 Euro		(15.7%)			
>48,000 Euro		(2.2%)			

The variables included in the model are reported in bold.

The questionnaire was structured in four parts. The first section focused on the food habits and the main features of the food purchases of respondents. The second section was aimed at investigating the consumption of salt-reduced food, paying special attention to bread consumption and its typology, including attributes such as sensory characteristics, packaging and geographic origin. This form of closed-ended questioning was used to capture the sensory evaluation of a low-salt content bread. For this reason a taste experiment was carried out in order to detect the most important attributes of salt-reduced sliced bread. The third section of the questionnaire covered the main aspects linked to the assessment of the WTP for a salt-reduced bread. The last section collected the social and economic characteristics of the interviewees. It included questions on the demographic characteristics of the sample (gender, age, level of education, number of household members, and annual income) and other personal information about the respondents such as body weight and height that would allow us to calculate the body mass index (BMI). This index is a metric used to estimate the amount of body fat a person has, taking into account the ratio between weight, expressed in kilograms, and height, expressed in meters (kg/m^2). Table 1 provides a brief description of the respondents' descriptive characteristics.

5. Results

5.1. Salt-reduced bread consumption: descriptive statistics

This section reports some descriptive statistics on the sample. The majority of the respondents stated that they are aware of the linkage between high sodium intake and negative health effects (78.8% of sample), thereby recognizing in many cases the excessive consumption of salt in Italy. Although this research was not aimed at detecting the interest of consumers in modifying their daily diet to reduce their salt intake, the trend observed appears to be in line with a previous study arguing that a large amount of people have an increasing awareness of salt reduction (Newson et al., 2013). We also found that more than half of the interviewed people (56.7%) stated that they purchase foods with specific health functions such as foods with supplements of minerals, amino acid supplements, vitamin supplements, as well as energy bars, yogurt, probiotics, and products low in fat, sugar, and/or salt. This confirms the strong interest of consumers in functional food as widely recognized in recent food consumption literature (Urala and Lähteenmäki, 2003; Verbeke, 2005; Annunziata and Vecchio, 2013; Verneau et al., 2014).

The average daily household expenditure of respondents for bread rounded to €2.60 while the average daily amount of bread consumed was 1.40 kg per household.

Consumers prefer to make their purchases from large retail stores (almost 40% of sample), followed by discount and traditional stores that round to 22% and 20%, respectively.

The purchase of food in other places, such as local markets or directly from producers, represents an important channel, but home deliveries, which include mail order, e-commerce, box schemes, and solidarity purchasing groups, are still not so common (see Figure 1). These latter data appear to be in line with the current trends of modern Italian consumer behavior (Cicia et al., 2011; Lanfranchi et al., 2014; Caracciolo et al., 2016; Giampietri et al., 2016). The results also seem to support a positive interaction between

the environmental context and healthy eating attitudes given that the availability of such products in nearby shopping places should allow consumers to develop healthier eating habits (Glanz et al., 2007).

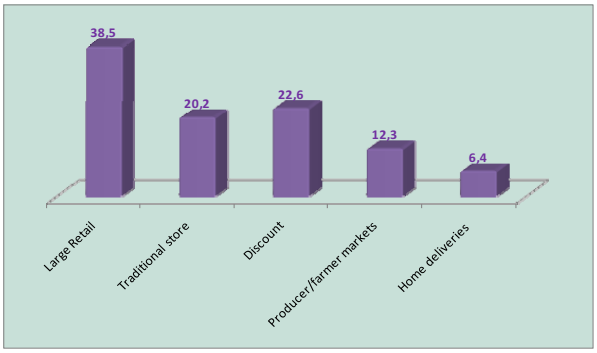


***Figure 1**–Purchasing places preferred by sample*

Sixty percent of the consumers sampled asserted that they had purchased salt-reduced products at least once. Accordingly, these people were asked to indicate which salt-reduced products they have ever purchased. According to the current food science literature, seven products were identified. These products, which belong to three different typologies (baked products, cured meat, and soups), vary considerably in the opinion of the respondents.

The majority of respondents placed a large value on baked products with a low sodium content (56%); bread, rusks, crackers, and breadsticks are the most purchased products. High preferences were also observed for processed and cured meat such as salami and ham. Over 15% of respondents stated they buy these sometimes.

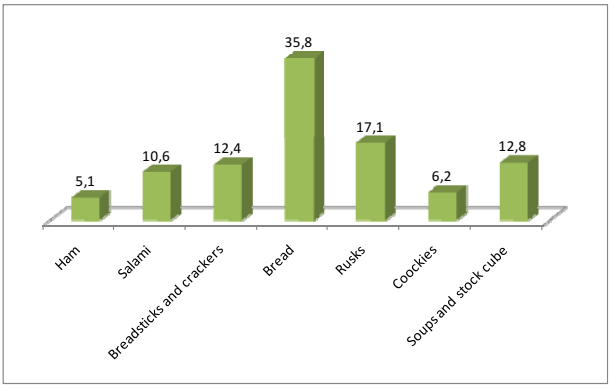


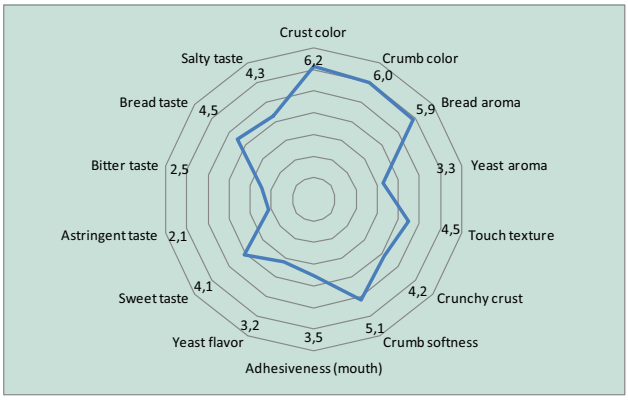
***Figure 2** –Purchase of main products with a low salt content*

This first outcome shows how consumers directly associate specific categories of processed food with a high salt content. For this reason, consumers seem to perceive the high level of dietary sodium in processed foods. This result appears to be consistent with previous research, thereby confirming that baked goods and cured meat are the

most widely consumed processed food products (Mattes and Donnnelly, 1991; Grimes et al., 2008; Liem et al., 2011). A high rate of preference was also observed for soups and stock cubes (12.8%), which represent the third largest group among the most important salt-reduced category products.

The first part of our survey was concluded with a sensory evaluation of wheat bread with a low-salt content. Consumers were asked to express their liking and organoleptic sensations for salt-reduced bread after having tasted it. The descriptive attributes of the bread were identified according to the specific categories employed in bread sensory perception (see Chlopicka et al.,2012; Jensen et al., 2011) by adopting a hedonic scale evaluation that took into account color, flavor, aroma, and the texture of the crumb crust. The attributes were expressed in a seven-point sensory scale whose range varied from 1 (low level of appreciation) to 7 (high level of appreciation).

The resulting mean scores of the bread sensory profile are shown in figure 3. The crust colour, crumb colour, and bread aroma were identified as the most important descriptors, with the scores ranging between 5.9 and 6.2. Positive preferences were also revealed towards crumb softness, touch texture, and bread taste, with the scores ranging between 5.1 and 4.5, while moderately acceptable sensory attributes were linked to a sweet taste and crunchy crust (4.2 - 4.1).



Level of appreciation: 1= low; 7= high

Figure 3 *–Spider diagram of sensory evaluation for salt-reduced bread*

These first findings allow us to point out that although a reduced sodium content negatively affects the texture of food (Doyle and Glass, 2010), consumers positively value the attributes linked to bread consistency and texture, thereby confirming that salt-reduced products can be considered by consumers as palatable food.

Salt taste perception and the role of sodium as a sensory attribute have been deeply analyzed in terms of liking and preferences (Liem et al., 2011; Doyle and Glass, 2010). The results on a general evaluation of our sample seem to be positive, although it should be stressed that the organoleptic evaluation consisted of a low-salt bread tasting. Consumers positively appreciate this descriptor but at the same time a negative correlation was found between taste perception and the reduced-salt label (Liem et al., 2012). As a consequence, we can confirm that a lower salt content does not affect the overall perception of saltiness. Thus, this result seems to be consistent with a previous study on

taste arguing that a reduction of sodium in salty food does not influence the food intake because the sensory characteristics of food generally are not so relevantly affected by a salt reduction (Lucas et al., 2011).

Our panel results showed a less favourable performance for the attributes of adhesiveness, yeast flavour, and yeast aroma. In these cases the respondents gave intermediate levels of evaluation, with the mean scores ranging from 3.5 to 3.2.

Conversely, the effects of sensory characteristics such as a bitter and astringent taste were totally negative; consumers assigned the lowest scores of 2.5 and 2.1, respectively, to these attributes.

Special attention was paid to those consumers who declared a low or zero level of interest in salt-reduced bread. The respondents were asked to explain the reasons that led them to not choose these specific products. The most relevant part of the respondents, more than 35%, stated they did not know this typology of product while almost one consumer in five asserted their difficulty in easily finding them in modern distribution channels such as supermarkets and large retail stores. Surprisingly, almost 26% of those sampled believed that these products would be consumed by an elderly person or addressed to people with specific pathologies. A high price was considered a critical and limiting food choice factor by only 12.3% of those sampled.

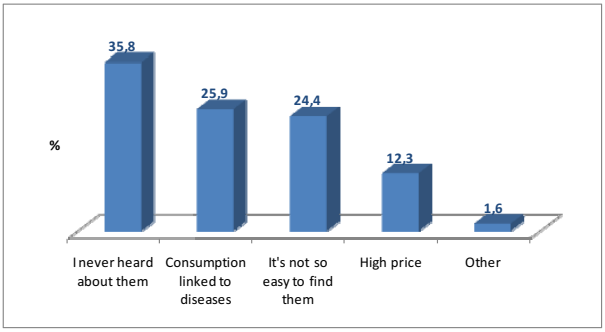


Figure 4 *– Reasons for not buying salt-reduced products*

5.2. WTP for bread with low salt content

The second part of our survey reports the estimated results.The estimation of the WTP distribution for salt-reduced bread through CV needs a hypothesis on consumers' indirect utility function shape and on the error distribution. In our study a multiplicative utility function was used while the error distribution was logistic. Table 2 reports the results of the logistic model.

The two parameters in the estimation are statistically significant and with expected signs. Using the estimated parameter it has been possible to draw the graph of the WTP distribution for low-salt bread. (Fig. 5). A large part of the sampled group would buy salt-reduced bread at a higher price than they would pay for a conventional one (i.e., € 2.20), thereby confirming implicitly the willingness of consumers to pay more for a product that "provides a health benefit" (Bitzios et al., 2011). Put differently, it seems that a part of the group sampled considers the absence of salt to be a superior feature for bread.

Table 2. *Logistic regression results*

Obs.	100	Log likelihood	-48.038
LR chi^2 (1)	24.35	Pseudo R2	0.2022
Prob> chi^2	0.000		
Dep. Var. WTP	Coef.	Std. Err.	z-stat
Log BID	-3.491	0.795	-4.39***
Constant	3.018	0.878	3.44***

*Note: *p< 0.10; **p<0.05; ***p<0.01*

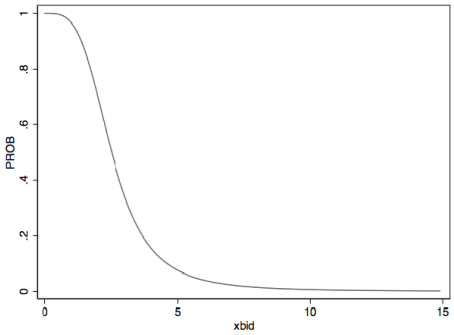


Figure 5 *– WTP probability density function*

This important aspect is better illustrated in Table 3, which show the values at significant distribution centiles.

Table 3 shows that 50% of those sampled would buy low-salt bread if it costs €2.40, while only 25% of those sampled would pay € .30 (1.10 euro more than conventional bread). This result seem to be in line with previous research and confirms the positive correlation between bread consumer preferences and health benefits (Bitzios et al., 2011) and the increasing awareness by bread consumers of healthy attributes (Dewettinck et al., 2008).

Table 3 *– Marginal WTP for low-salt bread at significant centiles*

Centiles of WTP distribution	Monetary values (€)
0.05	1.10
0.25	1.80
0.50	2.40
0.75	3.30
0.95	5.60

To better characterize the sampled consumers, a second logit model was carried out by introducing covariates. Table 4 shows the results. As covariates, besides constant and log of bid, age, gender, physical activities variables (takes value 1 if an interviewee does physical activities on a regular base, 0 otherwise) and BMI were implemented.

Within covariates, the log-bid and physical activities dummy variable are statistically significant. As expected the log-bid variable has a negative sign, meaning that the lower the price of low-salt bread the higher will be the probability for consumers to buy it. On the contrary, the physical activities variable shows a positive sign, meaning that people who do physical activities are more willing to pay a premium price for a low-salt bread.

Table 4 *– Logistic regression results with covariates*

Number obs.	100	Log likelihood	-42.48
LR $chi^2(1)$	35.47.00	Pseudo R2	29.045
Prob> chi^2	0.000		
Dep. Var. DAP	Coef.	Std. Err.	z-stat
Log BID	-4.078	0.652	-4.35***
Physical activity	1.727	0.653	2.64***
Gender	0.271	0.616	0.44
Age	0.028	0.025	1.1
BMI	0.127	0.099	1.29
Constant	3.018	2.521	-0.54

*Note: *p< 0.10; **p<0.05; ***p<0.01*

In Table 5 the results of the average and median values of the WTP function of covariates in the interval of confidence of 95% are shown according to Krinsky and Robb's (1986) method. Considering both estimates, that is, with and without covariates, it can be seen that the mean and median values are very similar.

Given the mean of the price for traditional bread in the local market is around €2.20 per kg, our findings show a positive WTP equal to +21.36% for a bread with a low salt content. This highlights the positive but limited response that this specific bread typology has from consumers.

Table 5 *- Mean and median WTP with confidence interval (Krinsky and Robb)*

Measures	WTP	LB	UB	ASL*
Mean	2.67	2.34	3.26	0.000
Median	2.41	1.88	2.77	0.000

**Achieved Significant Level for testing H0: WTP<=0 vs. H1: WTP>0 (95%)*
LB: lower bound; UB: upper bound

5.3. BMI influence on consumers' WTP

Although current epidemiological studies have not confirmed a direct correlation of salt intake and obesity, there is evidence that salt can affect overweight and obese people. Rocchini et al. (1989) argued that the blood pressure of obese adolescents seems to be sensitive to dietary sodium and an exploratory study has recently observed an indirect association between obesity and salt intake in children (He et al., 2008). In addition, Venezia et al. (2010) highlighted a positive correlation between altered renal sodium handling in obese and overweight patients due to the overconsumption of sodium.

For these reasons we aimed to determine whether body mass can influence the choice of a product with a low salt content and what is the consumers' WTP for them. In order to detect a statistical association between BMI and WTP, we analyzed the WTP of each respondent classified in the different groups according to the different categories of BMI. According to previous literature (Garrouste-Orgeas et al., 2004), consumers' BMI, expressed as kg/m^2, was divided into four groups as follows: 1) Low weight consumers with BMI = <18.5 kg/m^2; 2) normal weight consumers with BMI =18.5–24.9 kg/m^2; 3) overweight consumers with BMI =25–29.9 kg/m^2; 4) obese consumers with BMI>30 kg/m^2.The estimated WTP for each individual has been calculated as follows and the results are reported in Table 6.

$$WTP_i = \hat{\pi}_i(y_i = 1) \times bid_i$$

Table 6 *– Average values of WTP related to BMI categories of respondents*

BMI Classes *		Frequency (%)	WTP
Under weight:	<18.5	9	2.16
Normal weight:	18.5–25	77	2.53
Over weight:	25–30	14	3.77
Total		100	

To estimate the relationships between the WTP and the BMI categories, the following linear model has been used and the results are reported in Table 7:

$$WTP_i=\alpha +\beta_1 Gender_i+\beta_2 Age_i+\beta_3 Phisical\ activity_i+\beta_4 BMI_i\varepsilon_i$$

Table 7 *– Linear regression model results*

WTP– expected value	Coef.	Std. Err.	t	P > t
Gender	-0.066	0.312	-0.21	0.832
Age	0.019	0.011	1.67	0.097
Phisical activity	2.155	0.292	7.37	0.000
BMI classes	0.501	0.252	1.99	0.049

R^2= 0.8059

The results show the role of the BMI in influencing the individual WTP for low-salt bread. In particular, the WTP progressively increases from the lower class (€2.16) to the higher class of BMI (€3.77), with a net WTP increase of €0.51. This result indicates that consumers falling into critical BMI categories, such as overweight individuals, are concerned about their choice of food.

Moreover, our results highlight that age and physical activity variables also positively influence WTP (Table 7). This is in line with what was expected; older individuals, who have a WTP for low-salt bread of €0.02 are more careful about the salt content in their food. Ceteris paribus, individuals who undertake physical activity on a regular basis show a higher WTP of €2.15. These outcomes verify that eating behavior is significantly affected by the physical and demographic characteristics of consumers, thereby confirming that social factors play a prominent role in consumers' healthy food choices (Story et al., 2008).

Finally, a positive relationship between age and WTP was observed. It is worth noting that age was implemented as a continuous variable. In this case the estimated coefficient represents the marginal WTP for a one unit increase in that variable (1 year of age), so the sample average increase of the WTP for low-salt bread increases by €0.019 per year. Put differently, an individual 10 years older than another shows a higher WTP equal to €0.19. This result seems to be reasonable since the older an individual is the more they care about their health, and it is consistent with a previous study that highlighted how older consumers are more interested in healthy food than younger consumers (Roininen et al., 1999).

6. Discussion and conclusions

This study allowed to acquire detailed information about the current trends of a particular healthy product and to present for first time the results of a survey on the consumption of salt-reduced bread, thereby contributing to the existing literature on the WTP for a specific dietetic product.

The study deals with the adverse health effects resulting from a high consumption of salt. The different range of topics covered by our survey has produced some very interesting findings with several implications for medical and nutrition professionals and food business companies involved in salt reduction programs.

The originality of this work lies in the limited availability of studies that specifically investigate this specific typology of product and estimate, for the first time, the WTP for a bread with a low salt content. The paper also highlights the key factors that contribute to extending the current demand for salt-reduced products and provides some useful insights for marketers and stakeholders. Furthermore market information on consumption habits observed in this paper is of great relevance for the bakery industry.

The main descriptive statistics on the habits and attitudes of metropolitan area bread consumers showed the prevalence of large distribution channels for bread and confirmed a special interest in processed food products with a low sodium content. Surprisingly, the color of the crust and crumbs were deemed to be the most important characteristics among the sensory attributes.

The WTP was estimated in order to determine whether consumers place a high value on salt-reduced bread. The results show a fairly limited WTP for bread with a low sodium content. The relevant values were calculated at 20% over the price of normal bread, highlighting how consumers are positively interested in this kind of product but their intention to pay an additional price is rather limited. This fact has interesting implications for producers. Loureiro (2003) stated that when the WTP for a new product is fairly small, the implementation of new technology production practices can negatively affect the profitability of the food processing industry if the associated costs are higher than the benefits. In this sense our results would suggest that bread producers should investigate the specific costs associated with the introduction of salt-reduced food technologies and see if these are justified given the level of consumers' appreciation.

Our findings also point out for the first time the role played by the physical activity levels and physical characteristics of the sampled consumers and show the role played by the BMI in significantly influencing the individual WTP for low-salt bread. In particular, the study highlighted an increasing WTP as the lower BMI categories moved to

include those with high BMIs. The latter result showed evidence of a certain risk consciousness among the more vulnerable subjects, such as the "overweight individuals", and should encourage policy makers and health institutions to put greater effort into developing a more widespread information campaigns and to refine their past strategies and policies.

Important implications of our study are relevant both to consumers and the food industry. To benefit consumers, the affixing of a label reporting the sodium content and the simultaneous offer of low-sodium bakery products could promote a better nutritional balance and assist consumers who wish to limit their salt intake.

Furthermore, our study found a direct correlation among the socio-economic characteristics of consumers and their healthy food attitudes, thereby confirming the findings of recent researchers (Glanz et al., 2007; Lalluka et al., 2007; Story et al., 2008).

The food industry has invested in research to introduce technological solutions for reducing the total content of dietary salt in foods (Ruusunen and Puolanne, 2005) and our insights suggest the food companies should exploit this market niche to satisfy the demand from some modern consumers who have demonstrated a liking for low-salt food.

Moreover, in light of high interest demonstrated by consumers and the limited willingness to pay a differential price for this product, this study might have implications also for policy makers. As a fact the findings of survey could assist policy makers to ameliorate the impacts of excessive salt consumption by improving the individual response of consumers in respect of their high sodium intake. Finally, because a good nutritional education begins at childhood and its positive effects last until a much older age, it would be advisable to introduce foods low in sodium in hospital canteens and in school meals, particularly in kindergartens and primary schools.

Nevertheless this study has two limitations. First, as this was an exploratory analysis, our sample was too small to be truly representative of the Italian population so the results of our study would need to be extended to overcome this limitation. Second, further research should be carried out in order to improve upon and enlarge the sample in other European countries in order to ascertain the current trends and results in a wider part of the European population.

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References

AIBI (2013). Association Internationale de la Boulangerie Industrielle, *Bread Market Report 2012.*

Alberini, A. (1995). Testing willingness-to-pay, models of discrete choice contingent valuation survey data, *Land Economics*, 71(1): 83-95

Amemiya, T. (1985). *Advanced Econometrics*. Harvard University Press.

Annunziata, A., Vecchio, R. (2013). Agri-food innovation and the functional food market in Europe: concerns and challenges. *EuroChoices 12* (2): 12-18.

Asaria, P., Chisholm, D., Mathers, C., Ezzati, M., Beaglehole, R. (2007). Chronic disease prevention: health effects and financial costs of strategies to reduce salt intake and control tobacco use. *Lancet, 370*: 2044-2053.

ASSICA (2012). L'industria delle carni e dei salumi, Rapporto Annuale, Associazione Industriale delle Carni e dei salumi.

Barreiro-Hurlé, J., Colombo, S., Cantos-Villar, E. (2008). Is there a market for functional wines? Consumer preferences and willingness to pay for resveratrol-enriched red wine. *Food Quality and Preference*, *19*(4): 360-371.

Bibbins-Domingo, K., Chertow, G. M., Coxson, P. G., Moran, A., Lightwood, J. M., Pletcher, M. J., Goldman, L. (2010). Projected effect of dietary salt reductions on future cardiovascular disease. *New England Journal of Medicine*, *362*(7): 590-599.

Bitzios, M., Fraser, I., Haddock-Fraser, J. (2011). Functional ingredients and food choice: results from a dual-mode study employing means-end-chain analysis and a choice experiment. *Food Policy*, *36*(5): 715-725.

Bochud, M., Marques-Vidal, P., Burnier, M., Paccaud, F. (2012). Dietary salt intake and cardiovascular disease: summarizing the evidence. *Public Health Reviews*, *33*(2): 530-552.

Cameron, T.A., Quiggin, J. (1994). Estimation using contingent valuation data from a dichotomous choice with follow-up questionnaire. *Journal of Environmental Economics and Management*, *27*(3): 218-234.

Caracciolo, F., D'Amico, M., Di Vita, G., Pomarici, E., Dal Bianco A., Cembalo, L. (2016). Private Vs collective wine reputation. *International Food and Agribusiness Management Review, vol*.19, issue 3, 191-210.

Carson, R.T., Flores, N.E., Martin, M.K., Wright, J.L. (1996). Contingent valuation and revealed preference methodologies: comparing the estimates for quasi-public goods. *Land Economics*, *72*(1): 80-99.

Chlopicka, J., Pasko, P., Gorinstein, S., Jedryas, A., Zagrodzki, P. (2012). Total phenolic and total flavonoid content, antioxidant activity and sensory evaluation of pseudocereal breads. *LWT-Food Science and Technology*, *46*(2): 548-555.

Cicia, G., Cembalo, L., Del Giudice, T. (2011). Consumer preferences and customer satisfaction analysis: a new method proposal. *Journal of Food Products Marketing***,** *17*(1): 79-90.

Cobiac, L. J., Vos, T., Veerman, J. L. (2010). Cost-effectiveness of interventions to reduce dietary salt intake. *Heart*, *96*(23): 1920-1925.

Costanigro, M., Appleby, C., Menke, S. D. (2014). The wine headache: consumer perceptions of sulfites and willingness to pay for non-sulfited wines. *Food Quality and Preference*, *31*: 81-89.

D'Amico, M., Di Vita, G., Monaco, L. (2016). Exploring environmental consciousness and consumer preferences for organic wines without sulfites. *Journal of Cleaner Production,* 120, 64-71.

Dewettinck, K., Van Bockstaele, F., Kühne, B., Van de Walle, D., Courtens, T. M., Gellynck, X. 2008. Nutritional value of bread: Influence of processing, food interaction and consumer perception. *Journal of Cereal Science*, *48*(2): 243-257.

Di Vita, G., D'Amico, M., La Via, G., Caniglia, E. (2013). Quality perception of PDO extravirgin olive oil: which attributes most influence Italian consumer. *Agricultural Economics Review*, *14*(2): 46-58.

Di Vita, G., De Salvo, G., Bracco, S., Gulisano, G., D'Amico, M. (2016a). Future market of pizza: which attributes do they matter", *AGRIS on-line Papers in Economics and Informatics*, Vol. 8, No. 4, pp. 59 - 71.

Di Vita, G., Pappalardo, G., D'Amico, M. (2016b). Exploring the determinants of consumption for an Italian traditional product: the case of pizza, *Quality Access-to-Success.* 17(S1), 216-221.

Di Vita, G., Bracco, S., D'Amico, M. (2017). Mapping the Italian cured meats' attributes: a qualitative approach. *Quality Access-to-Success*, 18(S2), 181-188.

Doyle, M. E., Glass, K. A. (2010). Sodium reduction and its effect on food safety, food quality, and human health. *Comprehensive Reviews in Food Science and Food Safety*, Vol. 9: 1-8.

Dötsch, M., Busch, J., Batenburg, M., Liem, G., Tareilus, E., Mueller, R., Meijer, G. (2009). Strategies to reduce sodium consumption: a food industry perspective. *Critical Reviews in Food Science and Nutrition*, *49*(10): 841-851.

Duley, L., Henderson-Smart, D.J. (1999). Reduced salt intake compared to normal dietary salt, or high intake, in pregnancy. *Cochrane Database of Systematic Reviews, Issue 3*: 1-15.

Garrouste-Orgeas, M., Troché, G., Azoulay, E., Caubel, A., de Lassence, A., Cheval, C., Timsit, J. F. (2004). Body mass index. *Intensive Care Medicine*, *30*(3): 437-443.

Giampietri, E., Finco, A., Del Giudice, T. (2016). Exploring consumers' behaviour towards short food supply chains. *British Food Journal*, *118*(3), 618-631.

Glanz, K., Sallis, J.F., Saelens, B.E., Frank, L.D. (2007). Nutrition Environment Measures Survey in stores (NEMS-S): development and evaluation. *American Journal of Preventive Medicine, 32*: 282-89.

Godlee, F. (1996). The food industry fights for salt. *British Medical Journal*, *312*(7041): 1239.

Grimes, C. A., Nowson, C. A., Lawrence, M. (2008). An evaluation of the reported sodium content of Australian food products. *International Journal of Food Science &Technology*, *43*(12): 2219-2229.

Haab, T. C., McConnell, K. E. (2002). *Valuing environmental and natural resources: the econometrics of non-market valuation*. Edward Elgar Publishing.

He, F. J., Marrero, N. M., MacGregor, G. A. (2008). Salt Intake Is Related to Soft Drink Consumption in Children and Adolescents. A Link to Obesity? *Hypertension*, *51*(3): 629-634.

He, F. J., Campbell, N. R., MacGregor, G. A. (2012). Reducing salt intake to prevent hypertension and cardiovascular disease. *Revista Panamericana de Salud Pública*, *32*(4): 293-300.

Jensen, S., Oestdal, H., Skibsted, L. H., Larsen, E., Thybo, A. K. (2011). Chemical changes in wheat pan bread during storage and how it affects the sensory perception of aroma, flavour, and taste. *Journal of Cereal Science*, *53*(2): 259-268.

Krinsky, I., Robb, A. L. (1986). On approximating the statistical properties of elasticities. *The Review of Economics and Statistics*, 715-719.

Kristiansen, I. S., Gyrd-Hansen, D., Nexøe, J., Bo Nielsen, J. (2006). Willingness-to-pay for a population program aimed at reducing dietary salt in Denmark. *Preventive Medicine*, *43*(1): 31-35.

Lanfranchi, M., Giannetto, C., Zirilli, A. (2014). Analysis of demand determinants of high quality food products through the application of the cumulative proportional odds model. *Applied mathematical sciences*, *8*(65-68), 3297-3305.

Laatikainen, T., Pietinen, P., Valsta, L., Sundvall, J., Reinivuo, H., Tuomilehto, J. (2006). Sodium in the Finnish diet: 20-year trends in urinary sodium excretion among the adult population. *European Journal of Clinical Nutrition, 60*(8): 965-970.

Liem, D. G., Miremadi, F., Keast, R. S. J. (2011). Reducing sodium in foods: the effect on flavor. *Nutrients*, *3*: 694-711.

Liem, D. G., Miremadi, F., Zandstra, E. H., Keast, R. S. (2012). Health labelling can influence taste perception and use of table salt for reduced-sodium products. *Public Health Nutrition*, *15*(12): 2340-2347.

Loureiro, M.L. (2003). Rethinking new wines: implications of local and environmentally friendly labels. *Food Policy*, 28: 547-560.

Louviere, J. J., Hensher, D. A., Swait, J. D. (2000). *Stated choice methods: analysis and applications*. Cambridge University Press.

Lucas, L., Riddell, L., Liem, G., Whitelock, S., Keast, R. (2011). The influence of sodium on

liking and consumption of salty food. *Journal of Food Science*, *76*(1): S72-S76.

Mason, H., Shoaibi, A., Ghandour, R., O'Flaherty, M., Capewell, S., Khatib, R., Jabr, S., Unal, B., Sozmen, K., Arfa, C., Aissi, W., Romdhane, H.B., Fouad, F., Al-Ali, R., Husseini, A. (2014). A cost effectiveness analysis of salt reduction policies to reduce coronary heart disease in four Eastern Mediterranean countries. *Plos One*; *9*(1): 1-10.

Mattes R.D., Donnelly, D. (1991). Relative contributions of dietary sodium sources. *Journal of American College of Nutrition, 10*(4): 383-393.

Maynard, L. J., Franklin, S.T. (2003). Functional foods as a value-added strategy: the commercial potential of "cancer-fighting" dairy products. *Applied Economic Perspectives and Policies*, *25*(2): 316-331.

Newson, R. S., Elmadfa, I., Biro, G., Cheng, Y., Prakash, V., Rust, P., Barna, M., Lion, R., Meijer, G. W., Neufingerl, N., Szabolcs, I., van Zweden, R., Yang, Y., Feunekes, G.I.J. (2013). Barriers for progress in salt reduction in the general population. An international study. *Appetite*, *71*: 22-31.

Palar, K., Sturm, R. (2009). Potential societal savings from reduced sodium consumption in the US adult population. *American Journal of Health Promotion*, *24*(1): 49-57.

Panzone, L., Di Vita, G., Borla, S., D'Amico, M. (2016). When consumers and products come from the same place: preferences and WTP for geographical indication differ across regional identity groups. *Journal of International Food and Agribusiness Marketing*, Vol.28, Issue 3, 1-28.

Rocchini, A. P., Key, J., Bondie, D., Chico, R., Moorehead, C., Katch, V., Martin, M. (1989). The effect of weight loss on the sensitivity of blood pressure to sodium in obese adolescents. *New England Journal of Medicine*, *321*(9): 580-585.

Roininen, K., Lähteenmäki, L., Tuorila, H. (1999). Quantification of consumer attitudes to health and hedonic characteristics of foods. *Appetite*, *33*(1): 71-88.

Ruusunen, M., Puolanne, E. (2005). Reducing sodium intake from meat products. *Meat Science*, *70*: 531-541.

Sacks, F. M., Svetkey, L. P., Vollmer, W. M., Appel, L. J., Bray, G. A., Harsha, D., Cutler, J. A. (2001). Effects on blood pressure of reduced dietary sodium and the dietary approaches to stop hypertension (DASH) diet. *New England Journal of Medicine*, *344*(1): 3-10.

Selmer, R. M., Kristiansen, I. S., Haglerød, A., Graff-Iversen, S., Larsen, H. K., Meyer, H. E., Bønaa, K. H., Thelle, D. S. (2000). Cost and health consequences of reducing the population intake of salt. *Journal of Epidemiology and Community Health*, *54*(9): 697-702.

Story, M., Kaphingst, K. M., Robinson-O'Brien, R., Glanz, K. (2008). Creating healthy food and eating environments: policy and environmental approaches. *Annual Review of Public Health*, *29*: 253-272.

Strazzullo P., Kandala N. B., Cappuccio F. P. (2009). Salt intake, stroke, and cardiovascular disease: meta-analysis of prospective studies. *British Medical Journal*, *339*: b4567.

Urala, N., Lähteenmäki, L. (2003). Reasons behind consumer's functional food choices. *Nutrition and Food Science*, *33*(4): 148-158.

Venezia A., Barba, G., Russo, O., Capasso, C., De Luca, V., Farinaro, E., Cappuccio, F. P., Galletti, F., Rossi, G., Strazzullo, P. (2010). Dietary sodium intake in a sample of adult male population in southern Italy: results of the Olivetti Heart Study. *European Journal of Clinical Nutrition*, 2010; *64*(5): 518-24.

Venkatachalam, L. (2004). The contingent valuation method: a review. *Environmental Impact Assessment Review*, *24*(1): 89-124.

Verbeke, W. (2005). Consumer acceptance of functional foods: sociodemographic, cognitive and attitudinal determinants. *Food Quality and Preference*, *16*: 45-57.

Verneau, F., Caracciolo, F. , Coppola, A., Lombardi, P. (2014). Consumer fears and familiarity of processed food. The value of information provided by the FTNS. *Appetite*, *73*: 140-146.

WHO (2007). *Reducing salt intake in populations: report of a WHO Forum and Technical Meeting*, 5-7 October 2006, Paris, France, World Health Organization, Geneva, Switzerland.
WHO (2012). *Guideline: Sodium intake for adults and children*. World Health Organization, Geneva, Switzerland.