Salt content of foods in Spain. 2012

GOBIERNO DE ESPAÑA
MINISTERIO DE SANIDAD, SERVICIOS SOCIALES E IGUALDAD
aecosan agencia española de consumo, seguridad alimentaria y nutrición

The NAOS Strategy, the initials of which stand for Nutrition, Physical Activity and Prevention of Obesity, is the response from the Ministry of Health, Social Services and Equality from the Government of Spain to the problem of obesity. Coordinated by the Spanish Agency for Consumer Affairs, Food Safety and Nutrition (AECOSAN), the NAOS Strategy aims to make the population aware of the problem that obesity represents for health, to promote health through healthy eating habits and physical exercise, and to bring together and promote those public or private initiatives that help to ensure that the public, in particular children and adolescents, adopt these healthy eating habits throughout their life.

For further information on the NAOS Strategy, the Observatory of Nutrition and of the Study of Obesity and the activities of AECOSAN please see our web page:

http://www.aecosan.msssi.gob.es/AECOSAN/web/subhomes/nutricion/aecosan_nutricion.shtml

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Edited by:

Spanish Agency for Consumer Affairs, Food Safety and Nutrition, 2015

NIPO: 690-14-006-5

Salt content of foods in Spain.
2012

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Recommended citation:

Salt content of foods in Spain. 2012. Spanish Agency for Consumer Affairs, Food Safety and Nutrition. Ministry of Health, Social Services and Equality. Madrid, 2015.

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FOREWORD

Public health intervention is one of the key factors in the prevention of disease, and particularly of noncommunicable diseases, which have the highest mortality and morbidity rates. The World Health Organisation (WHO) identifies a series of measures which should be implemented immediately to prevent deaths, cases of disease, and reduce the expenditure on the health service. One of these is the reduction of salt intake, and of the salt content in food. In addition, it is estimated that more than 70 % of the salt consumed in the diet comes from processed foods.

Both the public administrations and the private sector in Spain have been working on this line for many years. Public-private collaboration in this respect has been reinforced and renewed by means of numerous successive actions which the different sectors of the food and distribution industry have voluntarily adopted.

The reduction of the salt content in foods has been being addressed for a long time, consequently producing positive results, especially in some products, as for example bread.

Nevertheless, these favourable results must not lead to a lowering of the guard, and efforts must continue, and in some cases, be increased. The aim of this study is to uphold one of the pillars of the Plan to reduce salt consumption in Spain: the assessment. Assessment activities enable us to determine the situation of the salt content in food marketed in Spain, and in this way establish the priorities for intervention.

Collaboration between the Spanish Agency for Consumer Affairs, Food Safety and Nutrition (AECOSAN), through the NAOS Strategy, and food and distribution industry must continue along a strategic line in the Plan to reduce salt consumption. In this way it will be possible to contribute to attaining the final objective: to reduce the impact of cardiovascular disease in the population and in the health system.

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INTRODUCTION

Association between excess salt consumption and health

Noncommunicable diseases (NCD) are the principal cause of mortality all over the world. Of the 57 million deaths that occurred in the world in 2008, 36 million (almost two thirds) were due to NCD, and of these, 17.3 million people died of cardiovascular disease (CVD), equivalent to 30% of all the deaths registered in the world[1]. 7.3 million of these deaths were due to coronary heart disease, and 6.2 million to cerebral vascular disease[2]. In addition, these diseases are two of the most important causes of the disease burden, measured using the disability-adjusted life year (DALY)[3,4]

It is estimated that in 2030 approximately 23.3 million people will die from CVD, especially from heart disease and cerebral vascular disease, and it is expected to continue to be the main cause of death[1, 3, 5].

Arterial hypertension (AHT) is the most important risk factor related to NCD, and is responsible for between 13 and 16 % of all deaths, even ahead of smoking[1, 4, 6]. According to the World Health Organisation (WHO), AHT is responsible for at least 45 % of deaths due to heart disease, and 51 % of deaths due to ictus[7].

The global prevalence of AHT in the world, and in Europe, in individuals over 25 years, is estimated to be around 40 %, with a significantly higher prevalence in men than in women[1]. In Spain, the prevalence of arterial hypertension in adults was estimated to be around 33 %[8], although it reaches 40 % in middle age and 68 % among elderly people over 65, affecting approximately 10 million people[9].

The WHO have been warning about the links between nutrition, diet and the incidence and prevalence of noncommunicable diseases (NCD)[10]. One of the elements of the diet linked to NCD is the excessive intake of salt, such that the amount of salt consumed in diet is a very significant determining factor for blood pressure levels and cardiovascular risk[11-16]. The excessive intake of salt has also been linked to other diseases, including gastric cancer[17], or obesity[18].

Salt intake

When referring to the excessive intake of salt it is necessary to define certain recommended levels of consumption. The WHO recommends a maximum daily intake per person of 5 g of salt[10]. Other institutions such as the Food Standards Agency of the United Kingdom recommend a maximum daily intake of 6 g per person[19]. One of the

main problems when determining the intake of salt is how to measure it, due to the way it is consumed. Not only is salt consumed directly from the salt cellar when cooking or seasoning food, but the majority (77 %) of the salt consumed comes from processed food[20]. Although attempts have been made to use methods to estimate salt intake through the urinary sodium excretion in single urine samples[21-23], the most accurate method is the calculation of the urinary sodium excretion in 24-hour urinary samples[24], in spite of the increased complexity.

The mean daily intake of salt in adults in the world is estimated to be 9.88 g per person (range: 5.45 – 13.78), and 99.2 % of the global population have a mean daily intake of salt which exceeds the recommendations of the WHO[15]. The mean daily intake of salt in Spain was estimated using a study conducted by the Spanish Agency for Consumer Affairs, Food Safety and Nutrition (AECOSAN), at 9.8 g (SD: 4.6 g)[25]. That is, salt consumption in Spain is almost at the global average, almost double the WHO recommendations.

Reduction of salt consumption

In light of the above, the need to reduce the consumption of salt in the population is more than clear and justified. According to different studies, the reduction of the current consumption levels to the levels of the WHO recommendations would have a huge impact on arterial hypertension and on cardiovascular disease[26, 27], and would imply a significant economic impact for the health systems[28].

The WHO lists a series of cost-effective population measures, which should be put into place immediately to obtain rapid results in terms of the number of lives saved, diseases prevented and major costs avoided. One of these is "to reduce the intake of salt and the salt content in food"[1]. The Action Plan for implementation of the European Strategy for the Prevention and Control of Noncommunicable Diseases 2012-2016 establishes the reduction of the salt consumption as one of the 5 priority measures for reducing the impact of NCD[29].

In addition, during the Spanish Presidency of the European Union in 2010, and promoted by the Government of Spain, the "Council conclusions on actions to reduce population salt intake for better health"[30] were approved. In these conclusions the measures that should be taken at population level in order to reduce the impact on health of the excessive salt intake were broadly summarised. It states that: "tangible and coordinated measures are required, directed, for example, at making the population aware of the problem and reducing the salt content of food". That is, it highlights the two fundamental areas that must be strengthened in order to do so: awareness and provision of information to the population about the links between the excessive consumption of salt and health, and the reduction of salt content in food.

In several countries around the world and at the request of international organisations, work has been carried out for several years on the reformulation of food, and more specifically on the reformulation of the salt content. In 2009 a European

Framework for the Reduction of Salt[31]was created in the heart of the European Commission High Level Group on Nutrition and Physical Exercise, with the aim of coordinating, harmonising and reinforcing the actions of each of the Member States in the reduction of salt consumption. In addition, the WHO Regional Office for Europe develops and maintains the European Salt Action Network, ESAN, with the same objectives[32]. Therefore, the excessive consumption of salt comes under a global problem of public health which is on the political agendas of the EU Member States, and of the WHO.

In Spain, since 2005, the NAOS Strategy for Nutrition, Physical Activity and the Prevention of Obesity addresses all areas of nutrition linked to health, including the excessive intake of salt. In this way, as part of the NAOS Strategy in 2009 the Plan for the reduction of salt consumption in Spain[33] was set up, with the objective of bringing together all the measures aimed at achieving a reduction in the salt intake of the Spanish population, in the different areas. Since then, measures have been taken regarding the provision of information and the awareness of the population about the links between an excessive consumption of salt and health, and work is continuously underway on the reformulation of food.

Even before the start of the Plan to reduce salt consumption measures were already underway to achieve this. In 2004, a collaboration agreement was signed between what was then AESAN, the Spanish Confederation of Bakers (CEOPAN) and the Spanish Association of Manufacturers of Frozen Dough (ASEMAC) in which these institutions undertook to reduce the percentage of salt used in the manufacture of bread, from 22 g of NaCl/kg of flour to a maximum of 18 g of NaCl/kg of flour in a period of four years, decreasing gradually at the rate of 1 g per year. After the assessment carried out at the end of this period, it was confirmed that the objective had been widely met. In addition, the food industry also signed agreements with the AESAN in 2005 with commitments to reduce salt in food which, although no quantities were given, are of great value in demonstrating the desire of the private sector to collaborate in these initiatives, and to start to reduce the salt content in certain products.

Assessment and monitoring

The WHO has warned about the lack of monitoring of exposure and risk factors, activities which should be of top priority. As this suggests, monitoring of the salt content in food must be an assessment action[1].

Consequently, at the start of the Plan to reduce salt consumption, in 2009, the AESAN conducted a study to determine the mean intake of salt in the Spanish population[25], and a study to determine the salt content in foods in Spain, and the frequency of consumption, in order to estimate the groups of food which contribute most salt to the diet. From the results of this study, the contacts with the different sectors of the industry were strengthened in an effort to obtain quantifiable objectives.

Since then, assessment activities have continued to be a priority in the NAOS Strategy, and also of the salt consumption and content, and even more so with the creation of the Observatory of Nutrition and the Study of Obesity, as an information system for collecting relevant information[34].

As part of the assessment measures, information about the evolution of the salt content in food is considered to be of special interest, firstly in order to determine whether the trends are in response to the efforts of the institutions and industry in recent years. And secondly, given the results, in order to strengthen interventions in the groups of food in which there is a higher capacity for obtaining greater reductions.

Consequently, AECOSAN proposed carrying out this Study of salt content in foods in Spain.

OBJECTIVES

The main goals of this study are to:

1. To evaluate the salt content of processed foods in Spain.
2. To explore the trends of salt content in foods since the last study conducted in 2009.

As secondary goals:

1. To assess the possibilities of reducing the salt content in the different groups of food.
2. To establish priorities when planning objectives to reduce the salt content in the different groups of food.

METHODOLOGY

To decide which foods were to be assessed, the study conducted by the AECOSAN in 2009 was used, in which the salt content was analysed in 1,256 products selected after a market study, considering the relevance of the different trademarks and products. When purchasing these products, attempts were made to ensure that they exactly matched those analysed in 2009. If a product did not exist or had changed its presentation, another product of similar characteristics was used. The products were purchased in the fourth quarter of 2012.

The method used to determine the salt content in the products was the analysis of chlorines, conducted by an independent laboratory (AQUIMISA S.L.) using an ENAC-accredited procedure in accordance with the UNE-EN ISO/IEC 17025 standard.

The amount of salt is expressed in g of salt per 100 g of product.

The use of the term "salt" is preferred to that of "sodium", in accordance with the "Council conclusions on actions to reduce the population salt intake for better health"[30], due to the fact that the term "salt" is more easily interpreted by the general public. The method for converting a quantity of sodium into a quantity of salt is to multiply the amount of sodium by 2.5.

Once the quantity of salt in each of the products had been obtained, the products were grouped into categories or groups of food. In turn, and where possible, these groups were divided into subgroups, especially when the groups or categories contained very heterogeneous products.

The mean and median of the salt content was calculated for all the food as a whole, and also within each group. In addition, the minimum and maximum quantities of salt found in each of the food groups was determined.

To compare the salt content in food between 2009 and 2012, those products which were identical or very similar in both studies were selected. The rest were excluded in order to reduce possible bias. In addition, in the different groups, an individual inspection of each product was carried out, and those with extreme values were excluded (high or low), in order to avoid possible distortion due to measurement errors.

Certain food groups whose special characteristics imply that the comparison reduces the validity of the study, for example hams and mature cheeses, powdered soups and broths were also excluded from the comparison.

In addition, in the groups in which 5 or fewer products were analysed, the comparison was made but the statistical significance and the magnitude of the percentage of change were not considered.

In total, 751 products were selected for the comparison between salt contents in 2009 and 2012.

To assess the trends in salt content in the food, the difference of the median salt content for each food group in 2009 and 2012 was calculated, together with the percentage change from 2009 to 2012. To determine whether this difference was statistically significant, the Student t-test was performed for related samples, or the Wilcoxon signed-rank test for small samples. Only those foods which were exactly the same in the 2009 and 2012 studies were used in the comparison. The difference in the salt content was considered to be significantly different when the p-value was less than 0.05. A difference of at least 10 % was also considered to be relevant, even if it was not statistically significant.

In the comparisons by subgroups, only those subgroups in which the sample size was greater than 5 were considered.

RESULTS

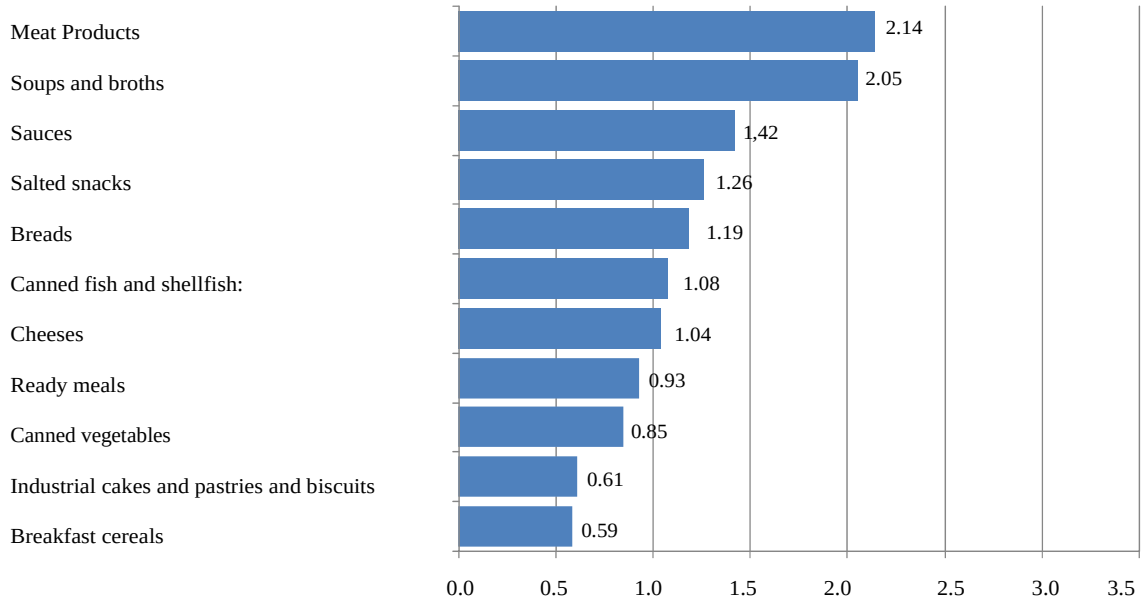
A total of 1,031 products were studied. These products were classified into 11 categories (Table 1).

Table 1. Groups and quantity of foods studied.

Salted snacks	49
Industrial cakes and pastries and biscuits	88
Meat products	185
Breakfast cereals	30
Canned fish and shellfish	131
Canned vegetables	118
Industrial bread	80
Ready meals	268
Cheeses	17
Sauces	35
Soups and broths	30
Total	1,031

Graph 1 shows the medians of the salt contents (g of salt /100 g of product) obtained in the different groups.

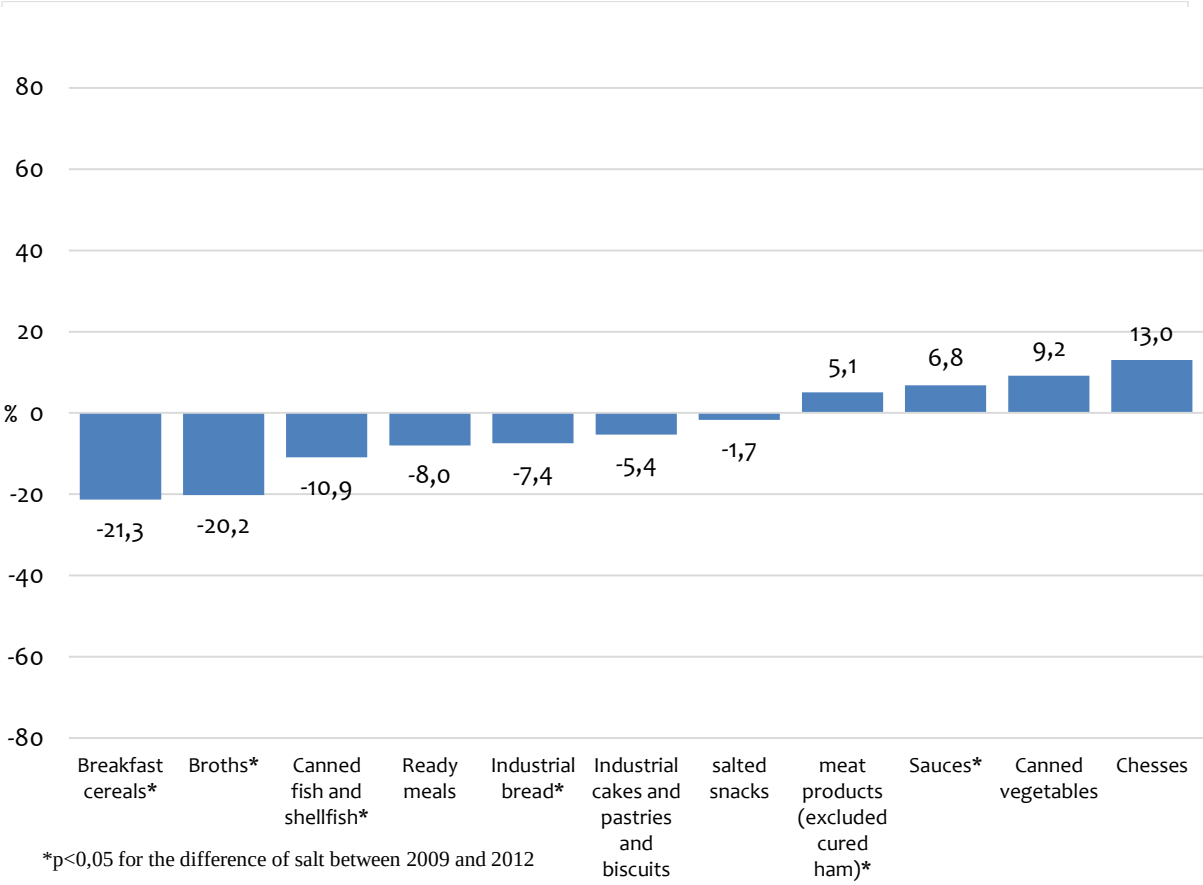
Graph 1. Content in salt in groups of food (g of salt / 100 g of product). Median. 2012



Of the groups analysed, the higher quantities of salt were observed in meat products, soups and broths, and the lowest content in the breakfast cereals, industrial cakes and pastries and biscuits, and canned vegetables. This does not necessarily mean that the products with the highest quantities of salt are the main providers of salt to the diet; to determine this it is necessary to consider the salt content, and the frequency of consumption of the food.

The percentages of change in the salt content between 2009 and 2012 are shown in graph 2.

Graph 2. Percentage change of salt content. 2009-2012



*p<0,05 for the difference of salt between 2009 and 2012

A statistically significant reduction in the salt content between 2009 and 2012 was observed in breakfast cereals, broths, canned fish and shellfish and industrial bread. No significant reduction was observed in industrial cakes and pastries and biscuits, ready meals and salted snacks. Statistically significant increases were observed in meat products, sauces, and no significant increases in canned vegetables, and cheeses.

Results by food group

The results obtained in each of the food categories are given below, together with the graphs in which the changes observed in the different subgroups between 2009 and 2012 can be seen. These graphs only give the subgroups in which the number of products analysed is greater than 5, and those subgroups which, due to the special method of preparation, have a high variability in salt content are excluded since the results of the comparison would not obtain the necessary validity.

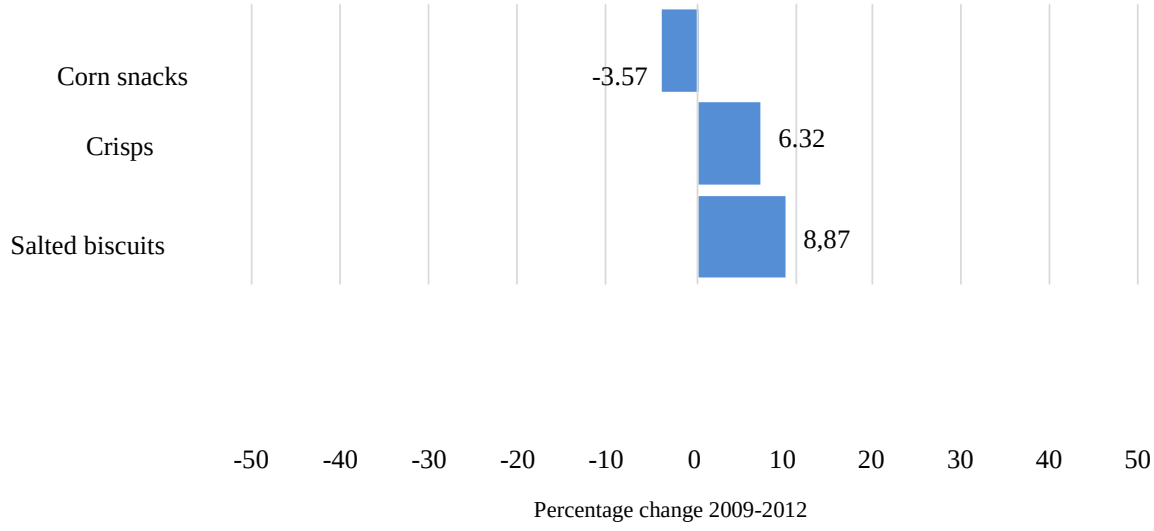
It is important to remember that all the products analysed in 2012 are shown in the tables. Nevertheless, some of these are not included in the comparison because they do not coincide with any of the foods analysed in 2009.

SALTED SNACKS

Table 2. Salted snacks. Salt content (g/100 g of product). 2012.

Subgroup	n	Median	Minimum	Maximum
Nuts	5	0.56	0.23	1.29
Salted biscuits	6	1.54	1.04	2.21
Crisps	22	1.03	0.45	2.78
Corn snacks	16	1.53	0.45	2.78
Total	49	1.26	0.23	278

Graph 3. Percentage change of salt content 2009-2012.
Salted snacks



*p<0.05 or percentage > 10%

In the subgroup of salted snacks no statistically significant variation was observed. This is a sector in which major efforts have been made to reduce salt content since 2005, which are not reflected in this 2009-2012 analysis, but which were made prior to this date. It should be noted that the dried fruit and nuts group was excluded from the comparison due to the low number of products analysed, although this group represents the highest percentage of sales in the sector. In addition, the salted biscuits group, although it is included in this group for the analysis, belongs to a different sector association than the other products. It is also important to highlight that the different samples of salted snacks, given the way in which the salt is included in the presentation and packaging, vary considerably even in the same product. Consequently, the results may also be affected by this. A slight increase was observed in the salt content in crisps and salted biscuits and a decrease in the corn snacks, although none of these differences were statistically significant.

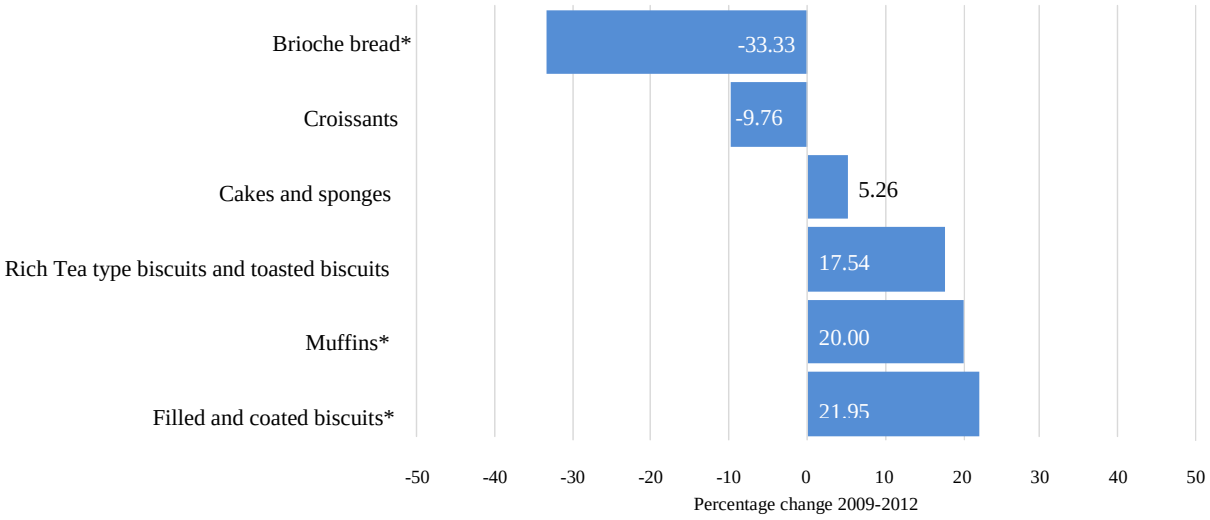
INDUSTRIAL CAKES AND PASTRIES AND BISCUITS

Table 3. Industrial cakes and pastries and biscuits. Salt content (g/100 g of product). 2012.

Subgroup	n	Median	Minimum	Maximum
Cakes and sponges	9	0.32	0.20	0.59
Industrial cakes and doughnuts	6	0.65	0.32	0.85
Croissants	8	0.79	0.52	1.06
Muffins	9	0.36	0.21	0.42
Brioche bread	7	0.82	0.62	1.25
Rich Tea type biscuits and toasted	33	0.67	0.21	0.99
Filled and coated biscuits	16	0.50	0.21	0.77
Total	88	0.61	0.20	1.25

The major decrease in the salt content in Brioche bread and the increase in the muffins (not significant) and in biscuits is of note in this group. In the case of biscuits, it should be noted that in absolute terms, this is the product with the lowest salt content of all those analysed in the study, and therefore any variation is reflected in a more visible percentage change. A decrease was also observed in croissants, and an increase in cakes and sponges (not significant). The subgroup "Industrial cakes and doughnuts" was excluded from the comparison because the sample size was less than 5.

Graph 4. Percentage change of salt content 2009-2012Industrial cakes and pastries and biscuits.



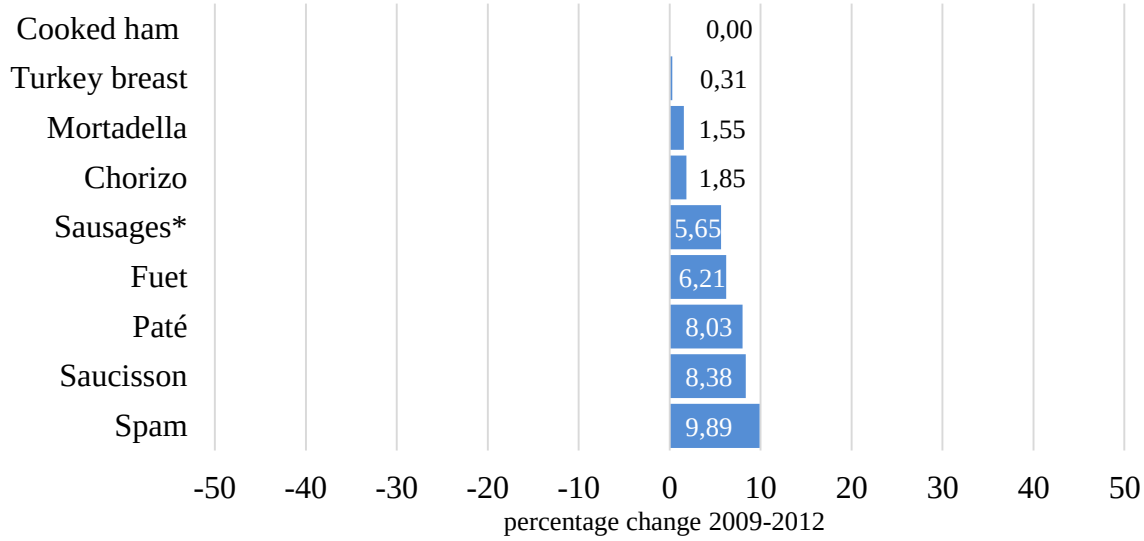
*p<0.05 or percentage > 10%

MEAT PRODUCTS

Table 4. Meat products (excluding cured hams). Salt content (g/100 g of product). 2012.

Subgroup	n	Median	Minimum	Maximum
Chorizo	10	3.58	2.94	3.86
Fuet-type sausage	6	3.94	3.64	4.31
Saucisson	14	3.36	1.96	4.21
Spam	11	1.94	1.42	2.35
Cooked ham	17	1.59	0.87	1.89
Turkey breast	12	1.60	0.84	2.01
Mortadella sausage	15	1.97	1.02	2.31
Pâté	14	1.41	0.96	1.85
Sausages	46	1.97	1.25	2.79
Total	145	1.89	0.84	4.31

Graph 5. Percentage change of salt content 2009-2012. Meat products (excluding cured hams).



*p<0,05 or percentage > 10%

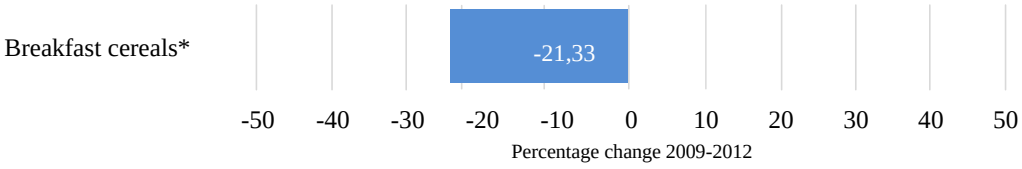
In the group of meat products, some increases were found, of a minor magnitude, all non-significant, except in the subgroup of sausages (which has the largest sample size). In the subgroups of cooked ham, turkey breast, Mortadella and chorizo there was almost no difference.

BREAKFAST CEREALS

Table 5. Breakfast cereals. Salt content (g/100 g of product). 2012.

Subgroup	n	Median	Minimum	Maximum
Breakfast cereals	30	0.59	0.26	1.55

Graph 6. Percentage change of salt content 2009-2012. Breakfast cereals



*p<0.05 or percentage > 10%

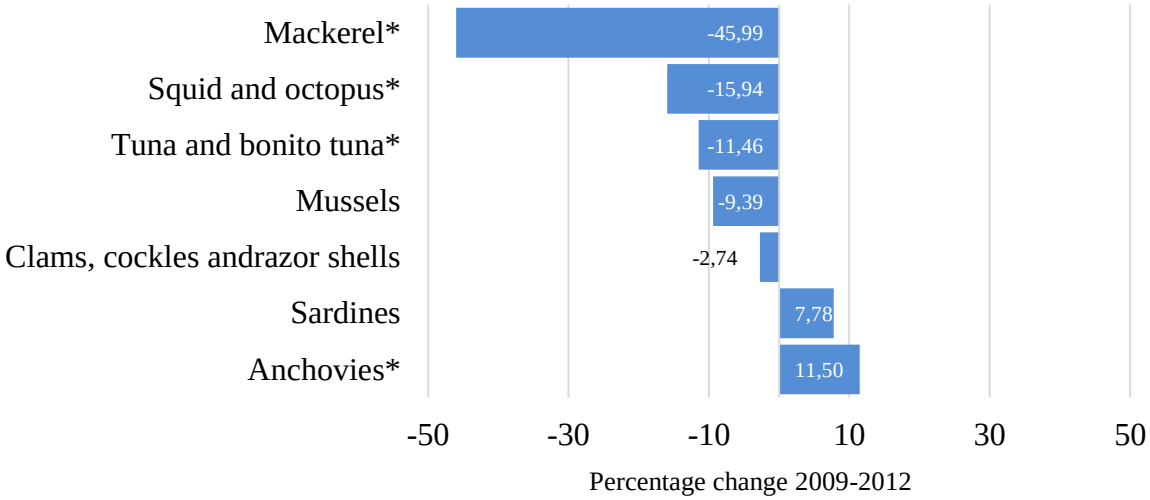
Breakfast cereals, in addition to having some of the lowest salt contents of all the groups, showed the greatest decrease since 2009, which was also very significant.

CANNED FISH AND SHELLFISH

Table 6. Canned fish and shellfish Salt content (g/100 g of product). 2012.

Subgroup	n	Median	Minimum	Maximum
Clams, cockles and razor shells	16	1.54	0.65	2.28
Tuna and bonito tuna	27	0.85	0.28	3.69
Mackerel	8	0.74	0.27	1.21
Squid and octopus	12	1.26	0.24	1.97
Mussels	16	1.49	1.01	2.41
Sardines	38	0.97	0.34	2.75
Anchovies	14	12.14	7.14	16.14
Total	131	1,19	0,24	16,14

Graph 7. Percentage change of salt content. Canned fish.



*p<0,05 or percentage > 10%

In the group of canned fish and shellfish. general decreases were observed, some significant and others of great magnitude. The two subgroups in which the salt content increased were anchovies and sardines.

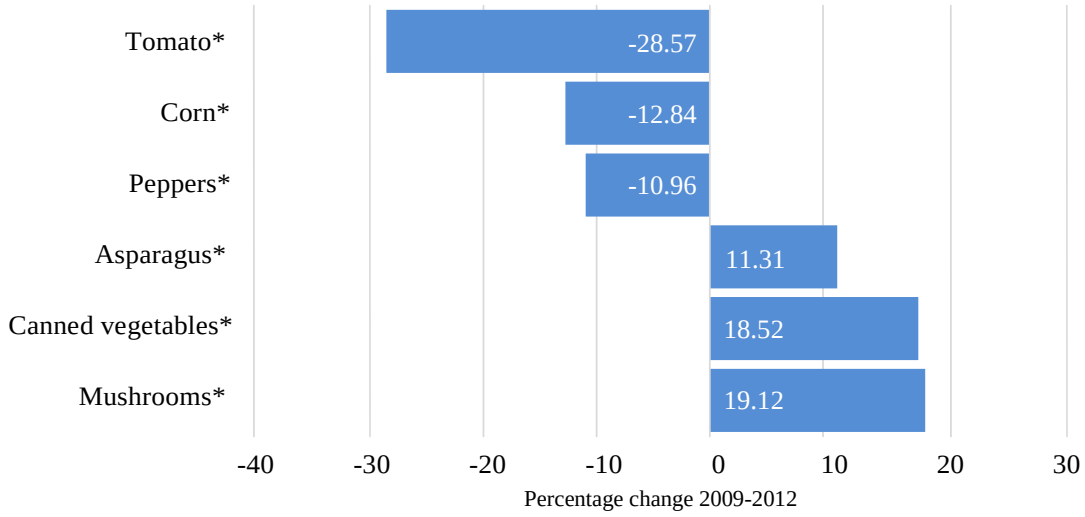
CANNED VEGETABLES

Table 7. Canned vegetables. Salt content (g/100 g of product). 2012.

Subgroup	n	Median	Minimum	Maximum
Canned vegetables	27	0.96	0.43	1.38
Asparagus	30	0.95	0.61	1.75
Corn	11	0.58	0.22	1.74
Peppers	20	0.75	0.24	1.48
Mushrooms	14	0.86	0.61	1.14
Tomato	16	0.5	0.23	1.49
Total	118	0.85	0.22	1.75

The results observed in the group of canned vegetables are uneven. Reduction in canned peppers, corn and tomato (the last of which was of great magnitude), and significant increase in canned mushrooms, vegetables and asparagus. None of the variations was statistically significant.

Graph 8. Percentage change of salt content 2009-2012.
Canned vegetables.



*Percentage > 10%

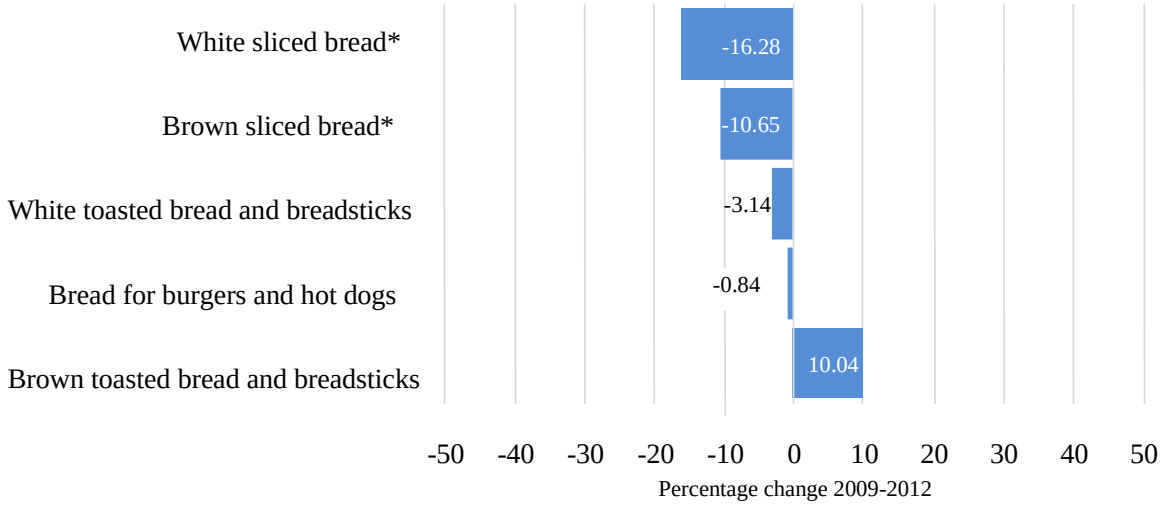
INDUSTRIAL BREAD

Table 8.Industrial bread. Salt content (g/100 g of product). 2012.

Subgroup	n	Median	Minimum	Maximum
Sliced bread	15	0.89	1.06	1.45
Brown and seed-based sliced bread	17	0.73	1.14	1.00
Bread for burgers and hot dogs	17	0.79	1.16	1.35
White toasted bread and breadsticks	21	0.21	1.27	2.18
Brown toasted bread and breadsticks	10	0.28	1.44	1.69
Total	80	1.19	1.06	2.18

Only industrial bread was studied in this group. Ordinary bread was not included. Major decreases were observed (statistically significant in the case of sliced brown bread) in almost all the subgroups, and with an overall and significant decrease of 7 % in the entire group.

Graph 9. Percentage change of salt content 2009-2012.
Industrial bread.



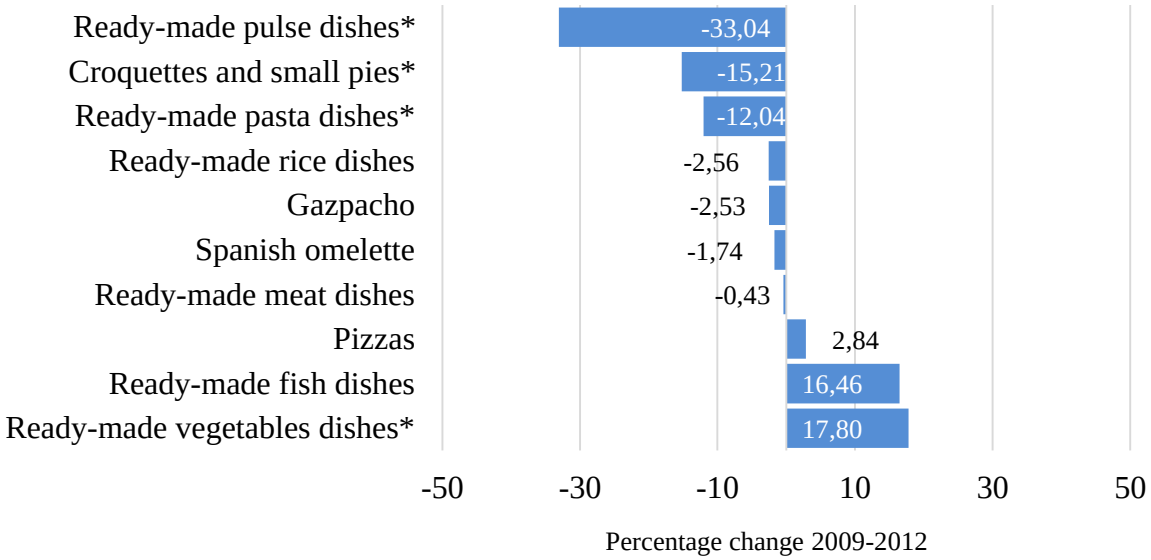
*p<0.05 or percentage > 10%

READY MEALS

Table 9. Ready meals. Salt content (g/100 g of product). 2012.

Subgroup	n	Median	Minimum	Maximum
Ready-made rice dishes	18	0.87	0.22	3.13
Ready-made meat dishes	27	1.18	0.71	1.98
Croquettes and small pies	14	0.94	0.71	1.43
Gazpacho	25	0.77	0.31	0.99
Ready-made pulse dishes	22	0.77	0.51	1.04
Ready-made pasta dishes	44	0.96	0.27	7.06
Ready-made fish dishes	28	0.86	0.25	1.44
Pizzas	27	1.45	0.68	1.78
Ready-made vegetable dishes	39	0.55	0.21	2.75
Refrigerated sandwiches	12	1.48	0.93	1.90
Spanish omelette	9	1.11	0.62	1.43
Total	267	0.92	0.21	7.06

Graph 10. Percentage change of salt content. 2009-2012.
Ready meals



*p<0,05 or percentage > 10%

The group of ready meals is the most heterogeneous group, with very different subgroups, and is even very heterogeneous within the same subgroups. Major

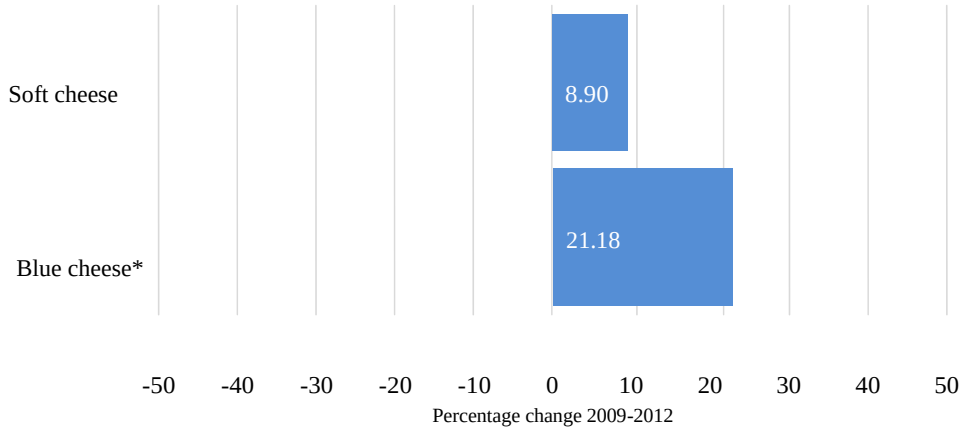
reductions were observed in the ready-made pulse dishes (statistically significant), croquettes and small pies, and pasta dishes. In addition, increases (not significant) were found in the ready-made fish and vegetable dishes. In the other subgroups the changes were minimal.

CHEESES

Table 10. Cheeses. Salt content (g/100 g of product). 2012.

Subgroup	n	Median	Minimum	Maximum
Blue cheese	6	3.14	2.41	3.96
Soft cheese	11	0.81	0.54	1.21
Total	17	1.04	0.54	3.96

Graph 11. Percentage change of salt content 2009-2012.
Cheeses



*p<0.005 or percentage > 10%

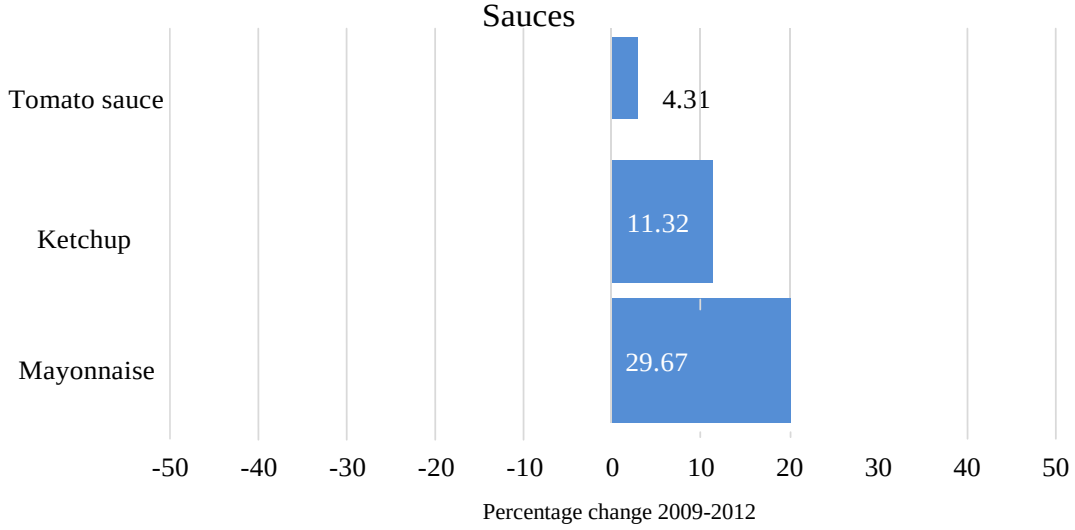
The cheese group is difficult to work with, given the huge variety, and the special characteristics of the preparation, resulting in huge variability, even within the same product. Therefore, different subgroups are excluded from the analysis, for example traditional pressed cheeses, and processed cheeses. In addition, due to the huge presence of products from outside Spain, and their influence on the final results without being able to take any measures regarding these cheeses, these were also excluded. A significant increase was observed in the blue cheeses, although the sample size was very small.

SAUCES

Table 11.Sauces Salt content (g/100 g of product). 2012.

Subgroup	n	Median	Minimum	Max
Ketchup	11	2.64	1.88	3.06
Mayonnaise	11	1.18	0.63	4.63
Tomato sauce	13	1.21	0.86	2.28
Total	35	1.42	0.63	4.63

Graph 12. Percentage change of salt content 2009-2012.
Sauces



*p<0.005 or percentage > 10%

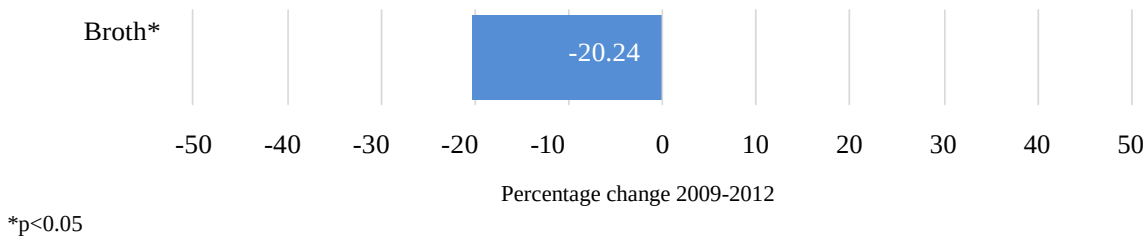
The sauces showed increases in salt content, and of note is the increase of almost 30 % (statistically significant) in the mayonnaises.

SOUPS AND BROTHS

Table 12. Soups and broths. Salt content (g/100 g of product). 2012.

Subgroup	n	Median	Minimum	Maximum
Broth	10	0.70	0.52	0.83
Soups	5	0.74	0.53	0.99
Stock cubes	5	8.59	3.93	10.21
Powdered stock	2	16.83	14.29	19.36
Powdered soup	8	5.76	3.11	8.54
Total	30	2.05	0.52	19.36

Graph 13. Percentage_ change of salt content 2009-2012.
Broth.



*p<0.05

In the soup and broth group, for the comparison between the salt contents in 2009 and 2012, only the broths were considered, as the sample size of the other products was too small. A statistically significant reduction of great magnitude was observed in the broths.

Evolution over time of salt content in food between 2009 and 2012

Although the principal results have been described in each group, it is of interest to determine certain details about some of the food groups which provide most salt to the diet. The European Commission High Level Group on Nutrition and Physical Exercise identified four groups of priority action, in view of the high salt content, and also due to the frequency of consumption, making them principal providers of salt in the diet. These groups were bread, processed meat products, cheese and ready meals[35]. The following results were found among the food groups considered the most important as providers of salt in the diet:

In the industrial bread group, there were reductions in almost all the product subgroups, in particular 16.3 % in white sliced bread (p = 0.099) and 10.7 % in sliced brown bread (p = 0.019).

In the meat products, no statistically significant differences were observed in either the cooked or cured meats. An increase of 5.7 % (p = 0.011) was observed in the sausages.

In the ready meals group, overall reductions in the salt content were observed, in particular 33.0 % (p = 0.05) in ready-made pulse dishes and 15.2 % (p = 0.202) in the croquettes and small pie group.

In the cheeses, as mentioned above, it is difficult to make a global analysis, due to the huge variability of products, and also within the same products, and the special characteristics of the preparation process.

In addition, a statistically significant reduction of more than 20 % (p = 0.003) was observed in breakfast cereals.

In other food groups, the general reduction of the salt content in canned fish and shellfish (except anchovies), and also the reduction of 20.2 % (p = 0.028) in broths is of note.

The detailed results are given in Table 13.

Table 13. Comparison of salt content (g/100 g of product) in food between 2009 and 2012. Wilcoxon signed-rank test.

	n	Median 2009	Median 2012	Diference	Percentage change	p
Nuts	4	0.95	0.52	-0.43	-45.50	0.273
Salted biscuits	6	1.41	1.54	0.13	8.87	0.917
Crisps	19	0,95	1.01	0.06	6.32	0.658
Corn snacks	13	1.40	1.35	-0.05	-3.57	0.345
Cakes and sponges	8	0.29	0.30	0.02	5.26	0.575
Industrial cakes and doughnuts	4	0.59	0.51	-0.08	-13.56	0.581
Croissants	7	0.82	0.74	-0.08	-9.76	0.672
Muffins	9	0.30	0.36	0.06	20.00	0.812
Brioche bread*	6	1.20	0.80	-0.40	-33.33	0.345
Rich Tea type biscuits and toasted	28	0.57	0.67	0.10	17.54	0.065
Filled and coated biscuits*	15	0.41	0.50	0.09	21.95	0.140
Chorizo	8	3.51	3.58	0.07	1.85	0.327
Fuet cured sausage	6	3.71	3.94	0.23	6.21	0.075
Saucisson	12	2.99	3.24	0.25	8.38	0.084
Spam	10	1.77	1.95	0.18	9.89	0.093
Cooked ham	13	1.59	1.59	0.00	0.00	0.701
Turkey breast	10	1.63	1.63	0.00	0.31	0.508
Mortadella sausage	11	1.94	1.97	0.03	1.55	0.859
Paté	13	1.37	1.48	0.11	8.03	0.279
Sausages*	37	1.77	1.87	0.10	5.65	0.011
Breakfast cereals**	27	0.75	0.59	-0.16	-21.33	0.003
Clams, cockles and razor shells	11	1.46	1.42	-0.04	-2.74	0.423
Tuna and bonito tuna**	26	0.96	0.85	-0.11	-11.46	0.144
Mackerel**	7	1.37	0.74	-0.63	-45.99	0,063
Squid and octopus**	7	1.38	1.16	-0.22	-15.94	0.018
Mussels	14	1.55	1.40	-0.15	-9.39	0.615
Sardines	27	0.90	0.97	0.07	7.78	0.801
Anchovies*	13	10.87	12.12	1.25	11.50	0.075

*Statistically significant increase ($p<0.05$) and/or greater than 10 %

**Statistically significant decrease ($p<0.05$) and/or greater than 10 %

Table 13. Comparation of salt content (g/100 g of product) in food between 2009 y 2012. Wilcoxon signed-ranks test (cont).

	n	Mediana 2009	Mediana 2012	Diferencia	Porcentaje de cambio	p
Canned vegetables*	23	0.81	0.96	0.15	18.52	0.063
Asparagus*	22	0.84	0.94	0.10	11.31	0.055
Corn	8	0.74	0.65	-0.10	-12.84	0.889
Peppers	15	0.73	0.65	-0.08	-10.96	0.379
Mushrooms	11	0.68	0.81	0.13	19.12	0.504
Tomato	14	0.70	0.50	-0.20	-28.57	0.149
Sliced bread**	11	1.29	1.08	-0.21	-16.28	0.099
Brown sliced bread**	16	1.32	1.18	-0.14	-10.65	0.019
Bread for burgers amd hot dogs	15	1.19	1.18	-0.01	-0.84	0.842
Toasted bread and breadsticks	16	1.28	1.24	-0.04	-3.14	0.776
Toasted bread and breadsticks (Brown)	8	1.35	1.48	0.14	10.04	0.575
Ready-made rice dishes	12	0.78	0.76	-0.02	-2.56	0.272
Ready-made meat dishes	20	1.17	1.16	-0.01	-0.43	1.000
Ready-made pulse dishes**	9	1.15	0.77	-0.38	-33.04	0.050
Ready-made pasta dishes	33	1.08	0.95	-0.13	-12.04	0.313
Ready-made fish dishes	21	0.79	0.92	0.13	16.46	0.198
Ready-made vegetable dishes	18	0.59	0.70	0.11	17.80	0.868
Croquettes and small pies**	10	1.09	0.92	-0.17	-15.21	0.202
Gazpacho	20	0.79	0.77	-0.02	-2.53	0.667
Pizzas	19	1.41	1.45	0.04	2.84	0.444
Spanish omelette	8	1.15	1.13	-0.02	-1.74	0.575
Blue cheese*	5	2.55	3.09	0.54	21.18	0.080
Soft chesse	8	0.73	0.80	0.06	8.90	0.326
Ketchup*	8	2.34	2.61	0.27	11.32	0.262
Mayonnaise*	11	0.91	1.18	0.27	29.67	0.026
Tomato sauce	13	1.16	1.21	0.05	4.31	0.944
Broth**	6	0.84	0.67	-0.17	-20.24	0.028

*Statistically significant increase ($p<0.05$) and/or greater than 10 %

**Statistically significant decrease ($p<0.05$) and/or greater than 10 %

DISCUSSION

As already mentioned in the Introduction, the WHO considers the reduction of the salt content in food as a population measure that should be carried out immediately in order to obtain rapid results in terms of lives saved, diseases prevented and huge costs avoided[1].

In fact, the reformulation of food is one of the most important points in the reduction of salt consumption. This does not mean that other measures, including education, information and awareness are not relevant. However, it is with a combination of both types of measures that it is possible to obtain a greater impact in the reduction of the consequences of the related NCD.

In the case of salt, there are more and more initiatives which include reduction targets, or which are specifically intended to reduce salt consumption, both of a public[32] or private[36] nature.

Certain important points must be considered in the reduction of the salt content in food when recommending reductions.

Reductions in salt consumption must not be proposed in equal amounts for all food products. Salt, in addition to being a flavour enhancer, fulfils certain food safety functions due to its capacity for conservation in certain products, and it prevents contamination by microorganisms[37]. Consequently, prior to planning reduction measures, it is necessary to determine the characteristics of the food, and the safety limits involved in the reduction.

Another important aspect is the flavour of the food. It is difficult to plan measures to reduce salt if the flavour of the food is going to be affected, and thus the food is no longer popular among consumers. The food industry has certain misgivings and concern about the potential loss of consumers of products in which the salt content is reduced. In this respect, the ideal solution is to propose gradual small reductions over time, as the human palate can more easily adapt to small changes in salt content; in this way, small changes maintained over time become changes of great magnitude. It is important to combine the objection of reducing salt content with the food market, reaching an equilibrium in which all the stakeholders are able to contribute to the reduction of the impact of the NCD without harming anyone.

In spite of the above two conditions, and taking them into consideration, what is clear is that it is possible to obtain significant reductions in salt content. The results of this study have shown this, with major reductions in food groups including bread, cereals and ready meals. Encouraging results have also been observed in other countries, and in some of these work has been carried out for several years in this respect, in particular in the Scandinavian countries[38-40] and the United Kingdom[19], but in general throughout the world[41-47].

Different initiatives have shown that it is possible to obtain reductions in the salt content of food. In Spain, in 2004, the Ministry of Health signed an agreement with the Spanish Confederation of Bakers (CEOPAN) in which members of the Confederation agreed to reduce 4 g the salt content in flour (from 22 to 18 g), over 4 years, that is, 1 g per year. Following the assessment carried out it has been confirmed that the objectives were reached and even exceeded. Assessments have also been made of the reduction of salt content in bread in other countries, including the United Kingdom[48], Australia and New Zealand[49]. In Spain, other voluntary agreements have also been reached, including the agreement signed in 2012 between the AECOSAN, the Spanish Confederation of Meat Retailers (CEDECARNE), and the Association of Manufacturers and Distributors of Food Additives and Supplements (AFCA), in which they undertook to reduce the salt content in their products by 10 % over 2 years.

The food and distribution sectors in Spain have been working voluntarily and in a coordinated manner with the AECOSAN on the reformulation of food products, and specifically on the reduction of salt. A number of sectors have already been making major efforts to reformulate their products and reduce the salt content for several years. The results obtained in this study confirm that this is the case, given that reductions have been observed in several groups, some of which are of great relevance, as these groups are among the main providers of salt to the diet. As some of these measures to reduce the salt content were carried out prior to the date of this study, it is possible that they may not be reflected in the study. However this does not make them of any less importance or value.

From the start, the Plan to Reduce Salt Consumption in Spain sought agreements and voluntary actions to achieve reductions in the products. It is important to remember that the reduction must not just be obtained in the products which provide most salt or have the highest salt content, but that it should be a transversal reduction which affects all the products that contain salt; if this is not the case, food in which the salt content is not reduced would have relatively much higher quantities of salt than those foods for which reductions have been proposed. Each group and subgroup of food, even if the salt content is not high, should contribute to the global reduction of salt in the diet.

In the light of the results of this study, very favourable results have been obtained in certain groups, combined with those already obtained in several sectors. In any case, there is still room for improvement in some groups, with options to take measures to reduce the salt content.

In the four groups that provide most salt, on the positive side, the results in the breads (industrial) and ready meals are of note. Bread is a staple food, and is widely consumed; industrial bread also forms a significant part of the overall bread consumption, and its salt content is similar to that of ordinary traditional bread, for which a new assessment is required in the short term, as reductions in bread will have a potentially large impact on the reduction in the total salt intake[50]. Ready meals are the most complex group, in view of their great heterogeneity, and because they often

include several ingredients, the salt content may be significant. The decreases observed in several subgroups of ready meals suggest that manufacturers are working on this and are aware of the importance of this group.

The other two priority groups defined by the HLG are processed meat products and Cheeses. In the case of meat products, minor increases have been observed in some products (only significant in sausages), while others have remained stable, without changes since 2009, such as cooked ham and turkey breast. This is also important and should be seen as positive, although as this is a sector which has already worked considerably on reformulation it is still possible to obtain even more positive results in the future, especially for some products. Cured hams were excluded from the analysis of meat products, in view of the huge diversity and variability in the curing process, as this is a product in which salt is inherent to the nature of the product. Cheeses are also a group with special characteristics, and must be considered as such. There are numerous types of cheese, with different methods of preparation, and even within the same type, variations may be observed in the method and place of storage, the environmental conditions, seasons, etc. As already mentioned, traditional pressed cheeses and processed cheeses were excluded from the analysis, as the variability, and the special manufacturing processes were even more marked, together with the cheeses produced outside Spain, in view of the great weight they have in the sector. Therefore, a general analysis in this group would be particularly risky, considering, moreover that there is a wide range of low salt cheeses available in the market, a product which is also the result of measures taken by the sector in the past and which should be recognised.

The high percentage reduction of salt in breakfast cereals must be highlighted. This is a sector which has been working on the reformulation in salt, in spite of the huge variety of products contained in the cereals.

This is also the case with packaged broths, a food group in which the corresponding sector has been making huge efforts for some years to reduce the salt content.

In the remaining food groups, the reformulation work carried out in recent years is also reflected. This is the case of salted snacks, which although it is not one of the main salt providers, just from the definition and characteristics of the product itself, may pose more problems. In addition, and mentioned earlier, the intra-product variability is very high in this sector. Conversely, the huge efforts made by the salted snacks sector since 2005 are reflected in the present results, in which the stabilisation of the salt content after the previous reductions can be seen. The signing of a new agreement with the sector for further reductions, in addition to those already made, is also expected.

Canned fish has also shown that the sector has been carrying out reformulations for several years, and this is reflected in the results of this study.

It is also necessary to highlight the results obtained in biscuits, products traditionally associated with sugar, but which also contain salt. It is true that the percentage increase observed is high, but it should be remembered that the absolute quantity of salt is among the lowest of all the food subgroups analysed, implying that any absolute variation is reflected in a huge percentage change.

The study has certain limitations which must be considered, but this in no way affects its validity and its usefulness. The first of these is the selection of products analysed; the huge heterogeneity of the food market makes it extremely expensive and complicated to cover the whole range of available foods. This, to some extent, is mitigated by the use of sources of information about the consumption of food, and with the analysis of a large sample, as has been the case. This heterogeneity also means that the breaking down of the foods must be large scale, such that in some occasions the subgroups are smaller than is desirable; to avoid this effect as much as possible, the subgroups with the lowest sample sizes were rejected, and sound statistical tests were used. Classification into subgroups also implies a limitation in certain cases, as it is sometimes difficult to group certain products with others.

In spite of these limitations, the study continues to be useful and totally fulfils its objectives. Methodological rigour is an underlying premise for drawing valid conclusions, and this study has that. It is essential for the monitoring to be based on a methodology and adequate sample size.

With these results, the AECOSAN will continue working, with the collaboration of the sectors from the food and distribution industry, in order to recommend and obtain new reduction goals. This study will serve to define these new objectives, and to consolidate the achievements already obtained by food manufacturers. And never with the intention of singling out any sector of the food or distribution industry, but rather to try to help improve the composition of products with regard to their salt content, and in this way, to contribute to reducing its intake, and the impact of NCD, which is the ultimate goal.

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