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Monitoring Sodium and Potassium in Processed Foods

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Abbreviations

AES	Atomic Emission Spectrophotometry
AOAC	American Association of Analytical Chemists
CRMs	Certified Reference Materials
EU	European Union
ESAN	European Salt Action Network
FSAI	Food Safety Authority of Ireland
FDII	Food and Drink Industry Ireland
INAB	Irish National Accreditation Board
K	Potassium
LOQ	Limit of Quantitation
Na	Sodium
NSD	No Significant Difference
PAL	Public Analyst Laboratory
PABA	Para-aminobenzoic acid
SRP	Salt Reduction Programme
SLÁN	National Survey Lifestyle, Attitudes & Nutrition
Std Dev	Standard Deviation
QC	Quality Control
WHO	World Health Organisation

Purpose

The purpose of this report is to provide an overview of the results obtained in the FSAI salt monitoring surveys which have been conducted on annual basis since 2003.

Introduction

The leading cause of death across the globe are non-communicable diseases (NCDs) such as cardiovascular disease (CVD), cancers, chronic respiratory diseases and diabetes (Hyseni *et al.*, 2017). Just over four million annual deaths are thought to be caused by consuming too much salt (GBD 2015 Risk Factors Collaborators, 2016). Policies on salt reduction have been shown to have stronger positive effects than interventions targeting sugar and fats (Federici *et al.*, 2019). Salt reduction policies have also been demonstrated to be more cost effective - a five-year investment of £15 million by the UK Food Standards Agency (FSA) on a salt reduction programme is estimated to have prevented 6,000 cardiovascular deaths per year and saved approximately £300 million a year (NICE, 2010).

Acknowledging the importance of reducing salt intake in the Irish population, a voluntary Salt Reduction Programme (SRP) was established and coordinated by the Food Safety Authority of Ireland (FSAI) in 2003 (FSAI, 2020a). The SRP was in partnership with the food industry, Food Drink Ireland (FDI), Retail Ireland and various state bodies and organisations. The goal of the SRP was to achieve voluntary, gradual and sustained reductions in the salt content of processed foods. In 2013, the coordination of the SRP was given back to the food industry while the FSAI retained a monitoring role in terms of salt reformulation (FSAI, 2020b).

In terms of monitoring, the FSAI has identified eleven categories of processed foods which would impact an individuals' daily salt intake. The FSAI samples products from one or two of these processed food categories yearly and sends these foods to the Public Analyst Laboratory in Galway (GPAL) for sodium and potassium analysis. Owing to the potential use of potassium salt substitutes in the reformulation of foods, it is deemed important to assess the potassium content of these products as well as measuring the sodium content. The FSAI has recently published guidance to assist food businesses in the use of potassium salt substitutes entitled "Guidance Note 36 Best Practice on the Use of Potassium Based Salt Substitutes for the Food Industry".

It is believed that processed foods and out of home (OOH) foods account for approximately 75% of an individual's salt intake (Harnack *et al.*, 2017). While the FSAI has built extensive data in relation to the monitoring of processed foods, there is little information regarding out of home (OOH) salt sources in Ireland. Therefore, identifiying this information gap and in line with the recommendations of the FSAI report "Salt and Health: Review of the Scientific Evidence and

Recommendations for Public Policy in Ireland (Revision 1)" (2016), the FSAI undertook a pilot study in 2020 to investigate the feasibility in collecting OOH lunchtime food options for sodium and potassium monitoring purposes.

Method

1. Sample collection

- Each year one or two categories of processed foods (*n*11) are sampled and categorised as per sub-category (see Table 1)[1]. Samples are collected from a range of supermarkets and convenience stores within the locality of the sampling officers.
- Following collection, samples are labelled with a unique identifier survey code and sample code which corresponds to a populated excel sheet including the FSAI reference code, sample number, and product label information.
- Photographs of all sides of the product label are taken, uploaded and stored electronically.
- Samples are transported by courier to Public Analyst's Laboratory – Galway (GPAL) for sodium and potassium analysis.

2. Sample analysis

- All samples are analysed by GPAL *INAB Registration Number: 009T.*
- Samples are initially homogenised either directly or as aqueous slurries (dependent on sample type) dried and then ashed in a muffle furnace (520°C ± 20°C). Nitric acid is added to the ash and is acid-digested on a steam bath. The solution is then diluted (if necessary) and analysed for sodium and potassium using flame photometry (AES= Atomic Emission Spectrophotometry). Quality control (QC) checks are applied as part of monitoring method performance including internal and external QC, analysis of certified reference materials (CRMs) and repeatability. *In-House method 1/40 based on AOAC Official Method 969.23 (AOAC Official Methods of Analysis - 18th Edition, 2005).*
- Methodology for laboratory analysis of food products for nutritional declarations such as sodium is not defined in legislation. Many methodologies of laboratory analysis are available with different degrees of accuracy and applicability. However, allowances for differences between methodologies for analysis of food products are not applied to the current results.
- The Limit of Quantitation (LOQ) for samples tested is 10mg/100g for both sodium and potassium and was dependent on the initial sample weight taken for analysis.

[1] Please note that there was no specific randomised approach employed for sampling.

- The average sodium recovery is 92% (range 84 - 100%) based on combined CRM data (using NIST 1546 Meat & LGC 7103 Biscuit Reference Materials & External QC Data from Proficiency Testing Schemes).
- The average potassium recovery is 95% (range 92 - 104%) based on combined CRM data (using NIST 1546 Meat & LGC 7103 Biscuit Reference Materials).

3. Statistical analysis

- Results are analysed using RStudio v4.0.3[2] in 2021 and v4.1.1[2] in 2022.
- Frequency statistics (means and standard deviations) and independent t-tests are employed to assess long term and short-term changes in sodium content of processed foods

[2] Results from all samples collected since 2003 were re-analysed using R Studio.

Table 1 Products sampled from 2003 to 2021

Category	Sub-categories											
Soups	Fresh soup	Ambient soup	Canned soup	Dried soup								
Ready meals	Oriental dishes	Pasta dishes	Curry dishes	Pizza	Meat pies	Quiche						
Cooking sauces	Carbonara	Bolognese	Curry	Sweet & sour	Black bean							
Snack products	Corn chips	Extruded snacks	Luxury crisps	Pelleted snacks	Popcorn	Potato crisps	Salt & vinegar products	Oriental - style snacks	Weaning snacks	Healthier varieties	Pretzel-shaped snacks	Savoury snack biscuits
Processed meats	Sausages	Rashers	Pudding	Cooked ham	Continental meats							
Bread products	White	Brown	Wholemeal	Wholegrain	Speciality	Mixed flour	Unpackaged					
Breakfast cereals	Rice based cereals	Bran based cereals	Cornflake based cereals	Biscuit based cereals	Multigrain cereals	Muesli	All other cereal products (no added salt/low salt)					
Spreadable fats	Butter	Half-fat butter	Margarine (fat content >80% but <90%)	Fat spread (fat content >62% but <80%)	Fat spread (fat content >41% but <60%)	Fat spread (fat content <39%)	Blend (fat content >80% but <90%)	Blended spread (fat content>62% but <80%)	Blended spread (fat content >41% but <60%)			
Natural cheese	Regular cheese	Mature cheese	Reduced fat cheese									
Processed cheese	Processed cheese blocks, strips & slices	Reduced fat processed cheese: blocks, strips & slices	Processed cheese spreads	Reduced fat: processed cheese spreads	Snack packs							
Condiments	Ketchup	Salad cream	Mayonnaise	Brown sauce								

Table 2 Number of Samples collected from 2003-2021

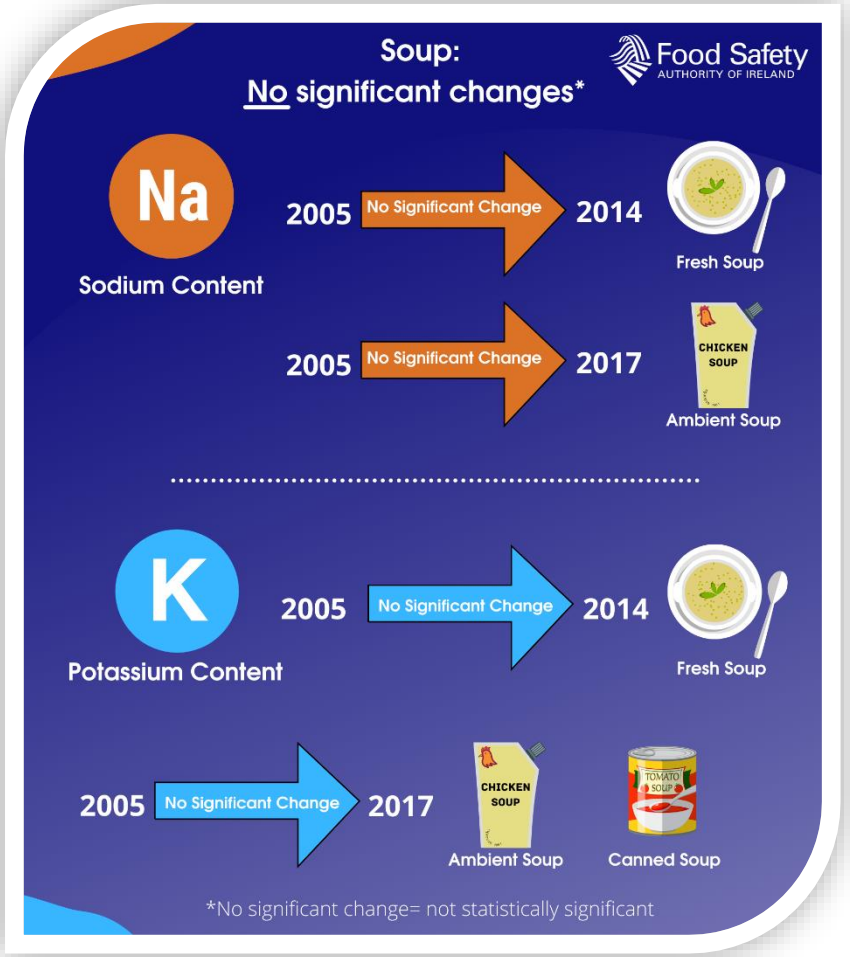
Category	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021	Total
Soups			126					114			42	103			44				**429**
Ready Meals		51					51					181							**283**
Cooking Sauces		52					71			48				78					**259**
Snack Products				136		97			137		102			59				100	**631**
Processed Meats		267		194			98			127			148				100		**934**
Bread Products	100			178					186		123		142			97			**826**
Breakfast Cereals	88				119				330				150						**687**
Spreadable Fats					72				90				90						**252**
Natural Cheese							34			56						93			**183**
Processed Cheese							36					173					107		**316**
Condiments															157				**157**
Unreported Data		122	82	12			2												**218**
Total	**188**	**492**	**208**	**520**	**191**	**97**	**292**	**114**	**743**	**231**	**267**	**457**	**530**	**147**	**201**	**190**	**207**	**100**	**5,175**

Background - tables 3 to 24

- Eleven categories of processed food are sampled and monitored (2003-2021) to determine mean levels of sodium and potassium. These foods are monitored at intervals which allows sufficient time for changes in their salt content to filter down into products available on the supermarket shelf. This is in line with the FSAI policy of encouraging gradual and sustained reductions in the salt content of processed foods. The interval for sampling typically ranges from 2 to 5 years.
- Values for sodium and potassium in processed foods from 2003 to 2010 were based on single product samples. From 2010 – 2018, a combination of single product and more representative sampling of products was undertaken where possible. In this case a two - three samples of each selected product (with different batch numbers and/or shelf-life declarations) is sampled and tested for sodium and potassium. From 2019, sampling of single product samples resumed.
- Some product formulations and labelling may have changed since these surveys were carried out. The analysis results presented in the tables reflect the situation at the time of product sampling.
- Where possible products are categorised based on their label description. In other cases, products are categorised based on industry practice and/or legislative descriptor.
- Results relate to both branded and private label products.
- Results relate to products as sold (including those products requiring reconstitution before consumption e.g., dried soups).
- All values are rounded to the nearest whole number.
- Statistical significance is the term used in assessing if a set of results/observations reflects a real pattern or one related to chance. In all tables statistical significance is set at p=0.05 (95%) confidence level (t-test two tail assuming unequal variance). All values are rounded to the nearest whole number.
- To convert sodium to salt: Multiply value by 2.54.
- To convert salt to sodium: Divide value by 2.54.

Soup

This section looks at the sodium and potassium content of soup between 2005 and 2017.



- A significant reduction was found for sodium content of canned and dried soups.
- No significant changes in sodium content were observed for fresh or ambient soups.
- No significant change in potassium content was found for fresh, ambient or canned soups.
- A significant increase in potassium content was observed for dried soup between 2005 and 2014.

Table 3 Soup products (mg/100g)

Category [a]	Sodium content per year of survey				2005 vs 2017 [h]	% Sodium content Change (2005 vs 2017) [h]	2014 vs 2017 [h]	% Sodium content Change (2014 vs 2017) [h]
	2005	2010	2014	2017 [g]				
Fresh soup [b]	280 (76)	230 (66)	246 [f] (57)	NT	NS	▼12 (2005 vs 2014)	NS	▲7
Ambient soup[c]	277 (65)	251 (77)	NT	241 (66)	NS	▼13	NS (2010 vs 2017)	▼4 (2010 vs 2017)
Canned soup [d]	362 (123)	268 (118)	324 (118)	242 (64)	<0.001	▼33	0.003	▼26
Dried soup [e]	4083 (1370)	3320 (1055)	3062 (806)	NT	<0.001 (2005 vs 2014)	▼25 (2005 vs 2014)	NS (2010 vs 2014)	▼8 (2010 vs 2014)
Total samples	126	114	145	44	Overall total = 429			

Results presented as means (standard deviations)**. a** Unless otherwise indicated all samples were analysed as sold. Varieties of soup sampled within each category: mushroom, vegetable, tomato and chicken; **b** Chilled soup; **c** Includes ambient soups packed in both flexible retort packs, pouches, tetra-packs and plastic pots; **d** Some canned/tinned soups are condensed and diluted before cooking/consumption (dilution varies by manufacturer); **e** Includes both dried packet, dried instant and concentrated liquid varieties. Dried and concentrated soups are diluted before cooking/consumption (dilution varies by manufacturer); **f** Samples taken at time periods (May and October 2013, April to May 2014); **g** Samples taken in August 2017; **h** Except were indicated. NS, not significant; NT, not tested.

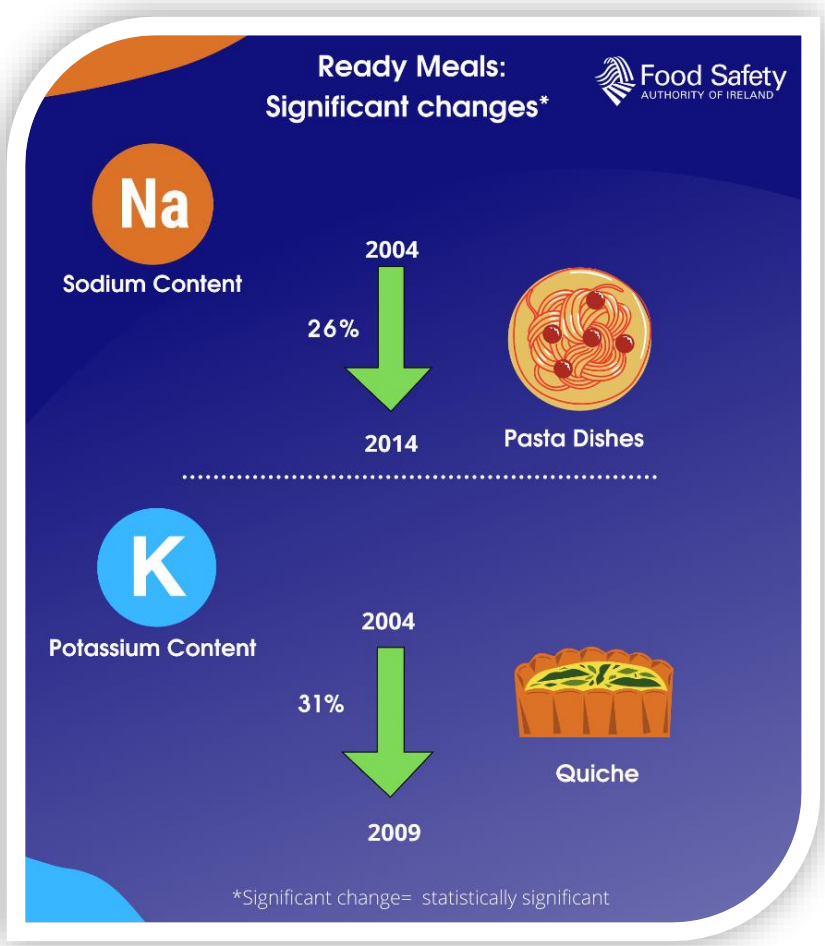
Table 4 Soup products (mg/100g)

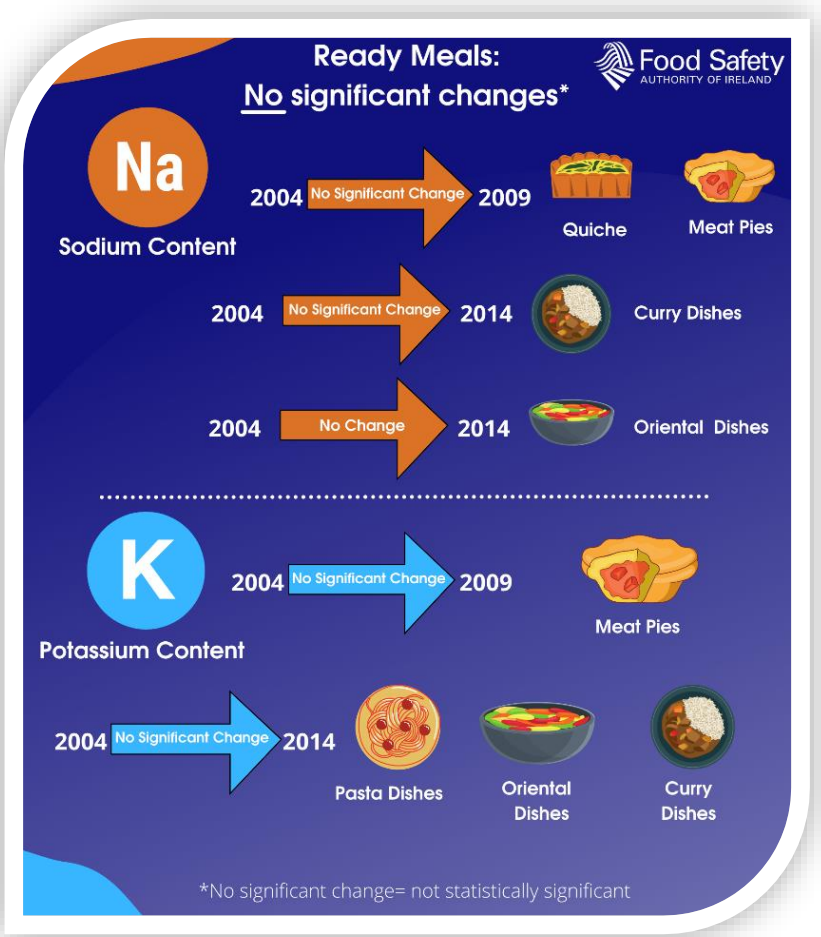
Category [a]	Mean potassium content per year of survey				2005 vs 2017 [h]	% Potassium content Change (2005 vs 2017) [h]	2014 vs 2017 [h]	% Potassium content Change (2014 vs 2017) [h]
	2005	2010	2014	2017 [g]				
Fresh soup [b]	119 (47)	142 (43)	134 [f] (42)	NT	NS	▲13	NS	▼6
Ambient soup [c]	106 (49)	166 (94)	NT	135 (51)	NS	▲27	NS	▼19
Canned soup [d]	99 (69)	106 (55)	118 (77) [f]	119 (61)	NS	▲20	NS	▲1
Dried soup [e]	623 (266)	762 (301)	732 (394) [g]	NT	0.037 (2005 v 2014)	▲17 (2005 v 2014)	NS (2005 v 2014)	▼4 (2005 v 2014)
Total samples	126	114	145	44	Overall total = 429 [i]			

Results presented as means (standard deviations)**. a** Unless otherwise indicated all samples were analysed as sold. Varieties of soup sampled within each category: Mushroom, Vegetable, Tomato and Chicken; **b** Chilled soup; **c** Includes ambient soups packed in both flexible retort packs and plastic pots; **d** Some canned/tinned soups are condensed and diluted before cooking/consumption (dilution varies by manufacturer); **e** Includes both dried packet, dried instant and concentrated liquid varieties. Dried and concentrated soups are diluted before cooking/consumption (dilution varies by manufacturer); **f** Samples taken at two time periods (May and October 2013, April to May 2014); **g** Samples taken in August 2017; **h** Except were indicated. NS, not significant; NT, not tested.

Ready meals

This section looks at the sodium and potassium content of ready meals between 2004 and 2014.





- No significant change was observed in the sodium content of Oriental Dishes, Meat Pies or Curry Dishes.
- Pasta Dishes reduced their sodium content by 26% between 2004 and 2014.
- No change in the sodium content of Quiches was observed.
- No changes in potassium content of any of the sub-categories with exception of Quiche which had a significant reduction of 31%.

Table 5 Ready meals (sodium in mg/100g)

Category [a]	Sodium content per year of survey			2004 vs 2014	% Sodium content Change (2004 vs 2014)	2009 vs 2014	% Sodium content Change (2009 vs 2014)
	2004	2009	2014				
Oriental dishes [b]	203 (148)	193 (76)	203 (74)	NS	No change	NS	▲5
Pasta dishes [c]	298 (72)	231 (68)	222 (81)	0.003	▼26	NS	▼4
Curry dishes [d]	276 (140)	224 (85)	215 (61)	NS	▼22	NS	▼4
Pizza [e]	NT	NT	370 (96)	NA	NA	NA	NA
Meat pies [f]	364 (140)	248 (79)	NT	NS (2004 v 2009)	▼32 (2004 v 2009)	NA	NA
Quiche [g]	398 (153)	308 (82)	NT	NS (2004 v 2009)	▼23 (2004 v 2009)	NA	NA
Total samples	51	51	181	Overall total = 283			

Results presented as means (standard deviations). **a** May include chilled and/or frozen samples**; b** May include Chicken, Beef or Pork Sweet & Sour, Black Bean, Chow Mein, Noddle Dishes and others; **c** May include Lasagne (Beef, Pork or Vegetarian), Cannelloni and others; **d** May include Indian, Thai and Chinese Chicken, Beef or Pork curries such as Tikka, Korma, Bhuna, Balti, Masala, Tandoori, Green & Red Curry and others; **e** New Category for 2014: samples include only Cheese and Margarita varieties; **f** May include Shepherds, Cottage, Steak & Kidney and Steak and one sample of beef stew for 2004 (Discontinued Sampling Category); **g** Typically Quiche Lorraine (Discontinued Sampling Category).

NA, results not available; NS, not significant; NT, not tested.

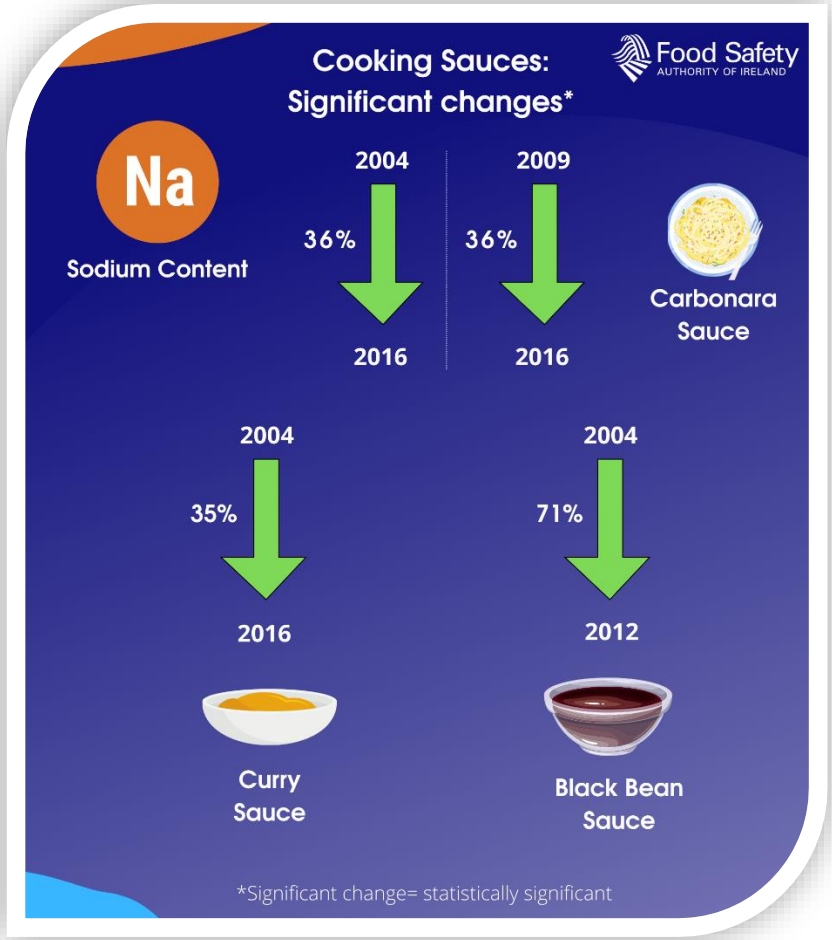
Table 6 Ready meals (potassium in mg/100g)

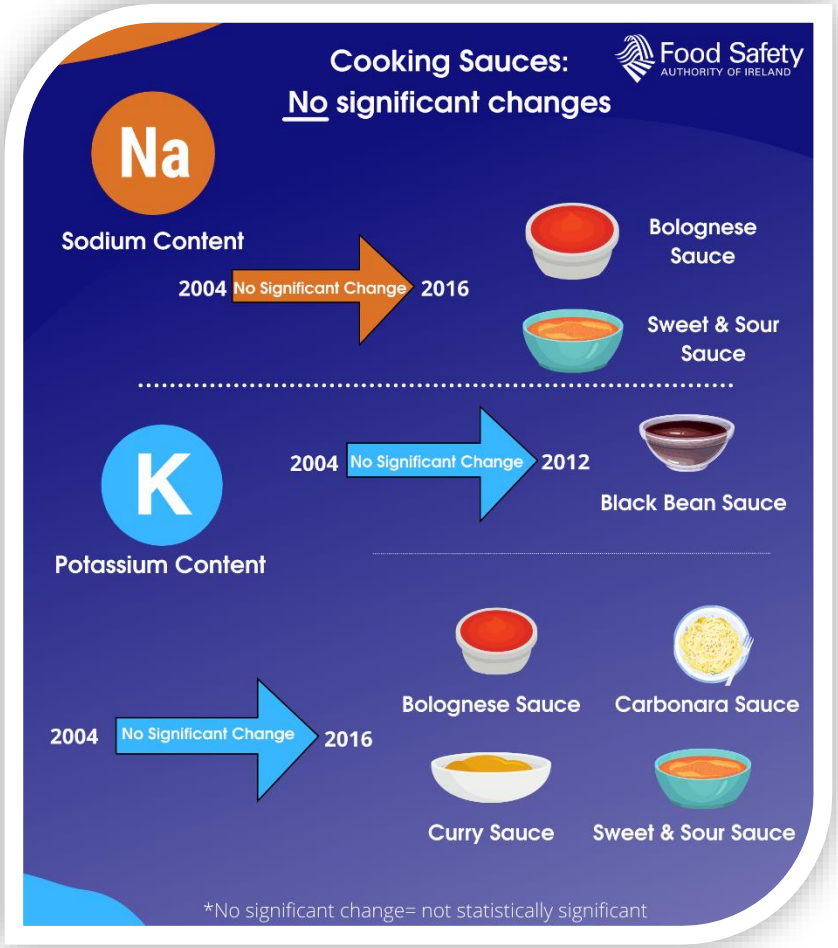
Category [a]	Mean potassium content per year of survey			2004 vs 2014	% Potassium content Change (2004 vs 2014)[h]	2009 vs 2014 [h]	% Potassium content Change (2009 vs 2014)
	2004	2009	2014				
Oriental dishes [b]	131 (35)	124 (17)	122 (19)	NS	▼7	NS	▼2
Pasta dishes [c]	207 (54)	188 (55)	203 (40)	NS	▼2	NS	▲8
Curry dishes [d]	168 (68)	165 (59)	190 (67)	NS	▲13	NS	▲15
Pizza [e]	Nt	Nt	185 (50)	NA	NA	NA	NA
Meat pies [f]	200 (39)	234 (64)	Nt	NS (2004 v 2009)	▲17 (2004 v 2009)	NA	NA
Quiche [g]	167 (21)	115 (38)	Nt	0.02	▼31	NA	▲8
Total samples	51	51	181	Overall total = 283			

Results presented as means (standard deviations). **a** May include chilled and/or frozen samples; **b** May include Chicken, Beef or Pork Sweet & Sour, Black Bean, Chow Mein, Noddle Dishes and others; **c** May include Lasagne (Beef, Pork or Vegetarian), Cannelloni and others; **d** May include Indian, Thai and Chinese Chicken, Beef or Pork curries such as Tikka, Korma, Bhuna, Balti, Masala, Tandoori, Green & Red Curry and others; **e** New Category for 2014: samples include only Cheese and Margarita varieties; **f** May include Shepherds, Cottage, Steak & Kidney and Steak and one sample of beef stew for 2004 (Discontinued Sampling Category); **g** Typically Quiche Lorraine (Discontinued Sampling Category).
NA, results not available; **NS**, not significant; **NT**, not tested.

Cooking sauces

This section looks at the sodium and potassium content of cooking sauces between 2004 and 2016





- The sodium content for black bean sauce reduced by 71% between 2004 and 2012. However, there was no significant reduction in the sodium content of black bean sauce between 2012 and 2016.
- A significant reduction in the sodium content of curry sauce was observed between 2004 and 2016. However, comparing 2012 and 2016, there was no significant reduction observed.
- No significant reduction in sodium content was observed for bolognese sauces and sweet & sour sauces.
- No significant changes were observed for potassium content across the time points.

Table 7 Cooking sauces (sodium in mg/100g)

Category [a]	Mean sodium content Per year of survey				2004 vs 2016 [e]	% Sodium content Change (2004 vs 2016) [e]	2012 vs 2016 [e]	% Sodium Content Change (2012 vs 2016) [e]
	2004	2009	2012	2016				
Carbonara [b]	444 (137)	443 (92)	NT	286 (85)	0.058	▼36	0.006	▼36 (2009 vs 2016)
Bolognese [c]	412 (105)	362 (160)	270 (86)	352 (219)	NS	▼15	NS	▲30
Curry [d]	505 (118)	353 (131)	316 (77)	331 (121)	< 0.001	▼35	NS	▲5
Sweet & sour	379 (197)	340 (163)	270 (96)	260 (56)	NS	▼31	NS	▼4
Black bean	1635 (1258)	706 (329)	472 (235)	NT	0.05 [g]	▼71 [g]	NS	▼33
Total samples	52	71	48	78 [f]	Overall total = 259			

Results presented as means (standard deviations)**. a** Includes jarred, pouch and other forms of ambient packaged samples. No fresh cooking sauces were sampled; **b** Cream based pasta sauces; **c** Tomato based pasta sauces and included in 2016, red pesto sauces; **d** Includes different varieties of curry sauce such as Tikka, Korma, Bhuna, Balti, Masala and Tandoori; **e** Unless otherwise stated; **f** Omitted Black Bean (*n*2); Chilli Con Carne (*n*3); Chow Mein (*n*2); Hoi Sin (*n*1); Thai Curry (*n*2). All omitted results are available on request to the FSAI; **g** Percentage sodium reduction between 2004 and 2012. NS, not significant; NT, not tested.

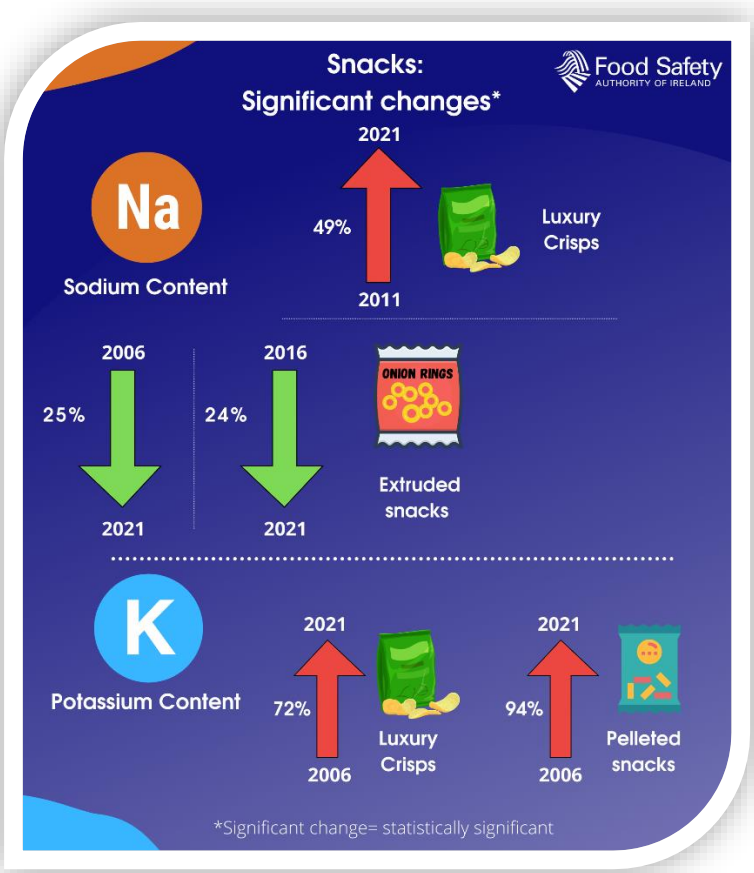
Table 8 Cooking sauces (potassium in mg/100g)

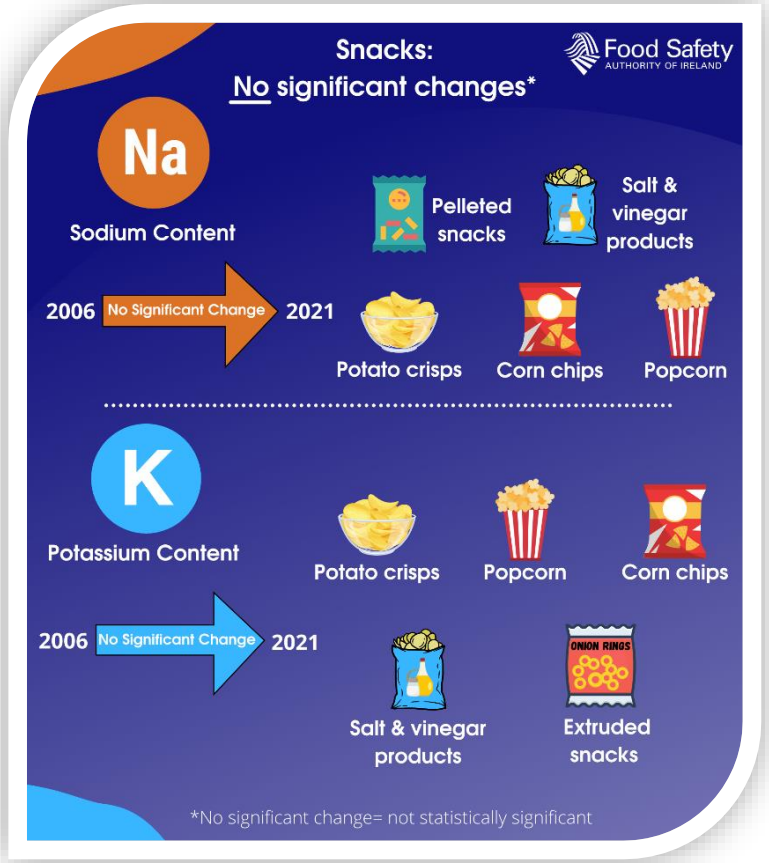
Category [a]	Mean potassium content per year of survey				2004 vs 2016 [e]	% Potassium content Change (2004 vs 2016) [e]	2012 vs 2016 [e]	% Potassium content Change (2012 vs 2016) [e]
	2004	2009	2012	2016				
Carbonara [b]	64 (26)	77 (43)	NT	45 (20)	NS	▼30	NS (2009 vs 2016)	▼41 (2009 vs 2016)
Bolognese [c]	353 (69)	315 (70)	282 (56)	349 (51)	NS	▼1	NS	▲24
Curry [d]	186 (41)	180 (48)	211 (103)	171 (69)	NS	▼8	NS	▼19
Sweet & sour	109 (37)	99 (18)	103 (24)	115 (35)	NS	▲5	NS	▲12
Black bean	156 (124)	104 (29)	122 (21)	NT	NS (2004 vs 2012)	▼22 (2004 vs 2012)	NS	▲17
Total samples	52	71	48	78 [f]	Overall total = 259			

Results presented as means (standard deviations)**. a** Includes jarred, pouch and other forms of ambient packaged samples. No fresh cooking sauces were sampled. Some products sampled include potassium chloride as an ingredient; **b** Cream based pasta sauces; **c** Tomato based pasta sauces and included in 2016, red pesto sauces; **d** Includes different varieties of curry sauce such as Tikka, Korma, Bhuna, Balti, Masala and Tandoori; **e** Unless otherwise stated; **f** Omitted Black Bean (n=2); Chilli Con Carne (n=3); Chow Mein (n=2); Hoi Sin (n=1); Thai Curry (n=2). All omitted results are available on request to the FSAI; **g** Percentage sodium reduction between 2004 and 2012. NS, not significant; NT, not tested.

Snacks

This section looks at the sodium and potassium content of snacks between 2006 and 2021.





- No significant reductions in sodium content were observed for any of the sub-categories with the exception for extruded snacks.
- Extruded snacks were found to have a 25% reduction in sodium between 2006 and 2021.
- For luxury crisps, a significant increase in sodium content was observed between 2011 and 2021 (49%).
- No significant reductions in potassium content were observed for any of the snack product sub-categories.
- For luxury crisps, a significant increase in potassium content was observed between 2006 and 2021 (72%).
- For pelleted snacks, a significant increase in potassium content was observed between 2006 and 2021 (94%).

Table 9 Snacks (sodium in mg/100g)

Category	Mean sodium content Per year of survey						2006 vs 2021 [e]	% Sodium content Change (2006 vs 2021) [e]	2016 vs 2021 [e]	% Sodium Content Change (2016 vs 2021) [e]
	2006	2008	2011	2013	2016	2021				
Corn chips	435 (171)	493 (248)	507 (156)	NT	NT	373 (137)	NS	▼14	NS (2011 v 2021)	▼26 (2011 v 2021)
Extruded snacks [a]	1036 (433)	895 (371)	1006 (161)	984 (277)	1030 (227)	780 (259)	0.026	▼25	0.011	▼24
Luxury crisps [b]	685 (280)	543 (134)	380 (135)	NT	NT	567 (208)	NS	▼17	0.044 (2011 v 2021)	▲49 (2011 v 2021)
Pelleted snacks [c]	846 (416)	778 (424)	778 (108)	880 (175)	755 (21)	571 (415)	NS	▼33	NS	▼24
Popcorn	796 (530)	575 (450)	758 (398)	NT	NT	566 (317)	NS	▼29	NS (2011 v 2021)	▼25 (2011 v 2021)
Potato crisps [b, d]	588 (262)	479 (222)	534 (120)	557 (135)	540 (179)	556 (143)	NS	▼5	NS	▲3
Salt & vinegar products	890 (355)	836 (253)	759 (180)	852 (282)	794 (217)	710 (132)	NS	▼20	NS	▼11
Healthier varieties [f]	NT	NT	NT	NT	NT	662 (260)	NA			
Oriental-style snacks [g]	NT	NT	NT	NT	NT	1084 (390)	NA			
Pretzel-based snacks	NT	NT	NT	NT	NT	1232 (493)	NA			
Savoury snack biscuits [h]	NT	NT	NT	NT	NT	705 (7)	NA			
Weaning snacks [i]	NT	NT	NT	NT	NT	72 (76)	NA			
Total samples	136	97	137	102	59	100	Overall total = 631			

Results presented as means (standard deviations)**. a** Food extrusion is a process in which a food material is forced to flow, under one or more varieties of conditions of mixing, heating and shear, through a die which is designed to form and/or puff-dry the ingredients ***e.g., onion rings*** can be described as puffed snacks also. There are many different raw materials which can be used for extruded snack production including potato, rice, maize, wheat, corn etc; **b** Potato (of various varieties) which are sliced (flat, crinkle cut etc), lightly fried in vegetable oil and then sprinkled with flavouring. **C** There are many different raw materials which can be used for pellet production such as: potato, rice, maize, wheat, corn etc. The pellets are divided into two basic categories, those made from grain (rice, maize, wheat, corn) or those made from potato. The latter being the only one to give the authentic potato taste to the finished product. Pelletised snacks are produced when the raw material is extruded into a recognisable shape, this can be done using a process known as direct expansion or alternatively using a process known as indirect expansion. The direct expanded pellets are produced in a one-step extruder and are ready for consumption following the extrusion process. The indirect expanded pellets are extruded and then generally sold on as a semi-manufactured product to companies who finish the process by frying them in hot oil then dosing them with flavouring or seasoning before packaging; **d** The majority of potato crisps sampled were Cheese and Onion flavour or variations of that flavour; **e** Unless otherwise stated. NS, not significant; NT, not tested; **f** Snack products presented as a healthier option due to cooking method or primary ingredient based on vegetable or lentil instead of grain; **g** Popadom or prawn cracker-based snacks; **h** Miniature savoury biscuit or crackers sold in a single serve portion pack; **i** Puffed and crisped snack products targeting infants and young children.

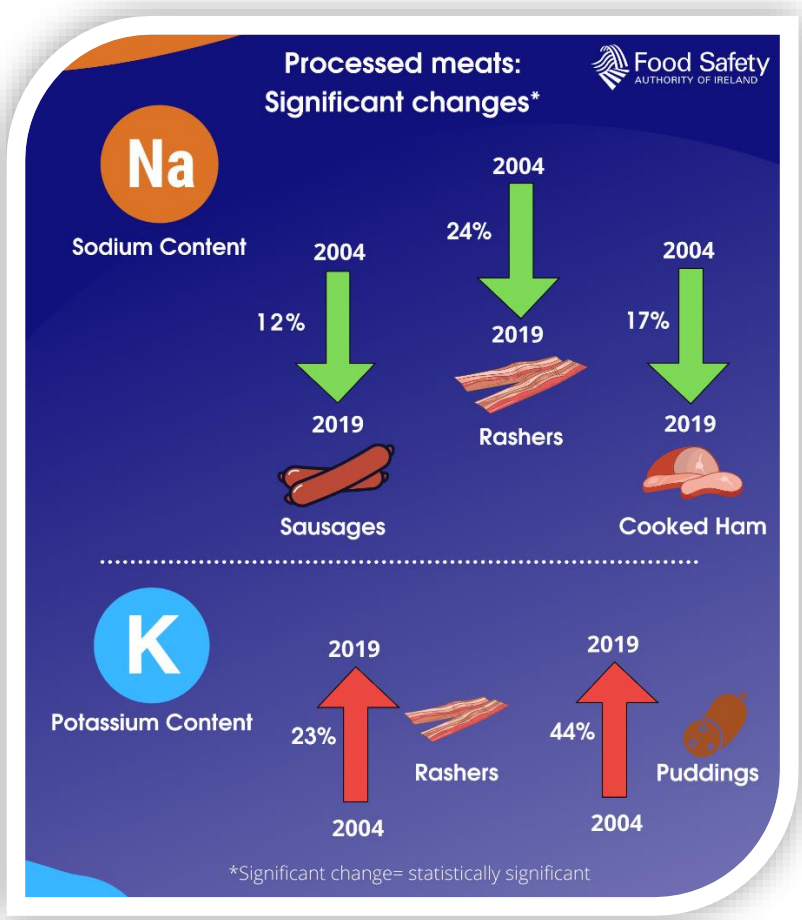
Table 10 Snacks (potassium in mg/100g)

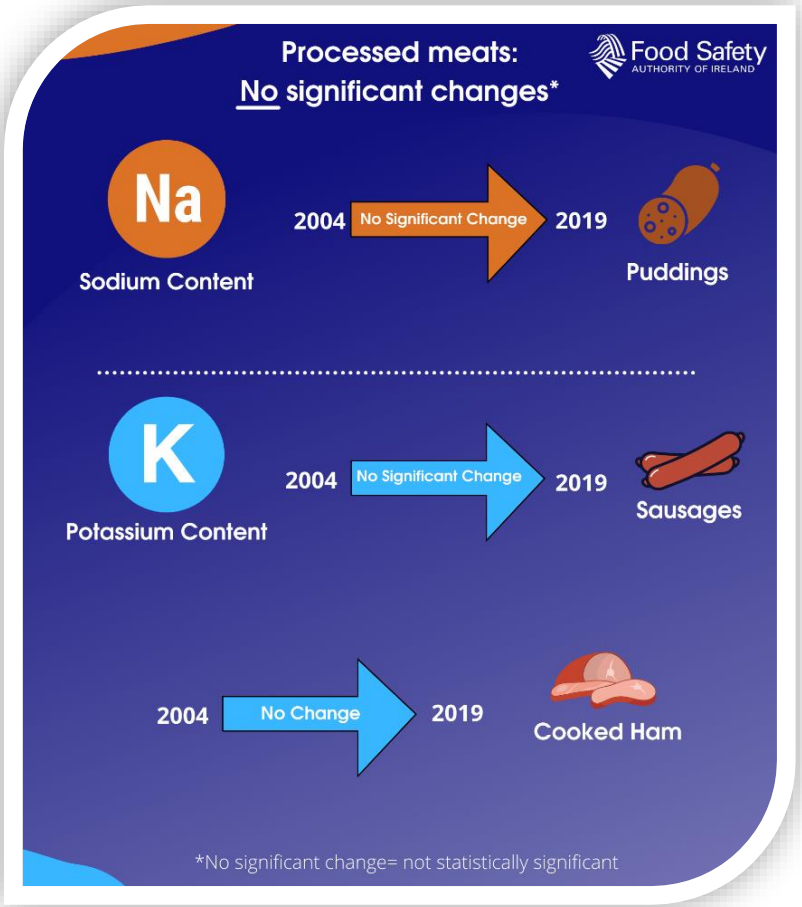
Category	Mean potassium content Per year of survey						2006 to 2021 [e]	% Potassium content Change	2016 to 2021 [e]	% Potassium Content Change
	2006	2008	2011	2013	2016	2021				
Corn chips	205 (41)	235 (58)	220 (39)	NT	NT	240 (64)	NS	▲17	NS *(2011 v 2021)*	▲9
Extruded snacks [a]	362 (298)	377 (227)	304 (83)	371 (180)	312 (124)	357 (189)	NS	▼1	NS	▲15
Luxury crisps [b]	777 (153)	975 (246)	1208 (278)	NT	NT	1333 (145)	<0.001	▲ 72	NS *(2011 v 2021)*	▲10
Pelleted snacks [c]	368 (273)	331 (189)	858 (62)	890 (51)	960 (42)	716 (409)	0.047	▲94	NS	▼25
Popcorn	321 (347)	172 (64)	230 (18)	NT	NT	188 (60)	NS	▼41	NS (2011 vs 2021)	▼18
Potato crisps [b, d]	1072 (237)	1116 (224)	1082 (283)	1269 (261)	1139 (219)	1182 (245)	NS	▲10	NS	▲4
Salt & vinegar products	1030 (568)	872 (311)	994 (363)	1281 (292)	1139 (230)	1170 (419)	NS	▲14	NS	▲3
Healthier varieties [f]	NT	NT	NT	NT	NT	858 (565)	NA			
Oriental-style snacks [g]	NT	NT	NT	NT	NT	264 (293)	NA			
Pretzel-shaped snacks	NT	NT	NT	NT	NT	246 (123)	NA			
Savoury snack biscuits [h]	NT	NT	NT	NT	NT	215 (35)	NA			
Weaning snacks [i]	NT	NT	NT	NT	NT	415 (184)	NA			
Total samples	136	97	137	102	59	100	Overall total = 631			

Results presented as means (standard deviations)**. a** Food extrusion is a process in which a food material is forced to flow, under one or more varieties of conditions of mixing, heating, and shear, through a die which is designed to form and/or puff-dry the ingredients ***e.g., onion rings*** can be described as puffed snacks also. There are many different raw materials which can be used for extruded snack production including potato, rice, maize, wheat, corn etc. **b** Potato (of various varieties) which are sliced (flat, crinkle cut etc), lightly fried in vegetable oil and then sprinkled with flavouring. **c** There are many different raw materials which can be used for pellet production such as: potato, rice, maize, wheat, corn etc. The pellets are divided into two basic categories, those made from grain (rice, maize, wheat, corn) or those made from potato. The latter being the only one to give the authentic potato taste to the finished product. Pelletised snacks are produced when the raw material is extruded into a recognisable shape, this can be done using a process known as direct expansion or alternatively using a process known as indirect expansion. The direct expanded pellets are produced in a one-step extruder and are ready for consumption following the extrusion process. The indirect expanded pellets are extruded and then generally sold on as a semi-manufactured product to companies who finish the process by frying them in hot oil then dosing them with flavouring or seasoning before packaging. **d** The majority of potato crisps sampled are cheese and onion flavour or variations of that flavour. Some brands of crisps sampled contained Potassium Chloride as an ingredient. **e** Unless otherwise stated. NS, not significant; NT, not tested. **f** Snack products presented as a healthier option due to cooking method or primary ingredient based on vegetable or lentil instead of grain. **g** Popadom or prawn cracker-based snacks. **h** Miniature savoury biscuit or crackers sold in a single serve portion pack. **i** puffed and crisped snack products targeting infants and young children**.**

Processed meats

This section looks at the sodium and potassium content of processed meats between 2004 and 2019.





- There was a significant reduction in the sodium content of all sub-categories with the exception of puddings between 2004 and 2019. In terms of short-term changes, there was no significant reductions in sodium content observed between 2015 and 2019.
- Sausages, rashers, and cooked ham all had a significant reduction in sodium content in 2015 compared with 2004 (12%, 24% and 17% respectively).
- Continental meats were found to have a higher sodium content in 2019 compared with any of the sub-categories sampled in 2004.
- A significant increase in potassium content was observed for rashers and puddings (23% and 44% respectively).
- No change in potassium content was found for sausages and cooked ham.

Table 11 Processed meats (sodium in mg/100g)

Category [a]	Mean sodium content Per year of survey						2004 vs 2019[i]	% Sodium content Change (2004 vs 2019)	2015 vs 2019[i]	% Sodium Content Change (2015 vs 2019)
	2004	2006	2009	2012	2015	2019				
Sausages [b]	881 (235)	950 (243)	810 (101)	823 (135)	782 (170)	776 (139)	0.015	▼12	NS	▼1
Rashers [c]	1315 (312)	1098 (297)	1150 (144)	1132 (365)	957 (185)	1002 (252)	< 0.001	▼24	NS	▲5
Pudding [d]	868 (237)	670 (160)	771 (145)	832 (166)	747 (127)	758 (172)	NS	▼13	NS	▲1
Cooked ham [e]	985 (240)	938 (162)	954 (135)	967 (125)	840 (132)	819 (169)	0.008	▼17	NS	▼3
Continental meats	NT	NT	NT	NT	NT	1514 (163)	NA	NA	NA	NA
Total samples	267 [f]	194 [g]	98 [h]	127	148	100	Overall total = 934			

Results presented as means (standard deviations). a Unless otherwise indicated all samples were analysed as sold i.e. raw. b Includes both pork and beef sausages; c Rashers of bacon are cured pork and may come from any part of the pig and maybe smoked or unsmoked i.e. green. The majority of samples analysed in the FSAI surveys were back and streaky rashers; d Includes both white and black varieties of traditional Irish blood puddings; e Ham is traditionally the cured product taken from the upper leg and buttock of the pig. However, the majority of samples analysed in the FSAI surveys were pre-sliced reformed or restructured hams including varieties such as crumbed, smoked, honey roast, deli and traditional which were loose, modified atmosphere or vacuum packed; f Results for Cooked Sausages (n=12); Bratwurst Sausage (n=1); Cooked Gammon Ham (n=15); Cooked Pudding (n=23); Cooked Burgers (n=9); Vegetarian Burger (n=1); Cooked rashers (n=55); Savoury Steak (n=2); Hot Dogs in Brine (n=1); Canned Cooked Ham (n=3); Raw Burgers (n=71); Gammon Ham (n=4); Cooked Beef (n=2) are omitted from results shown above. However, all omitted results are available on request to the FSAI. NA, results not available; NS, not significant; NT, not tested.

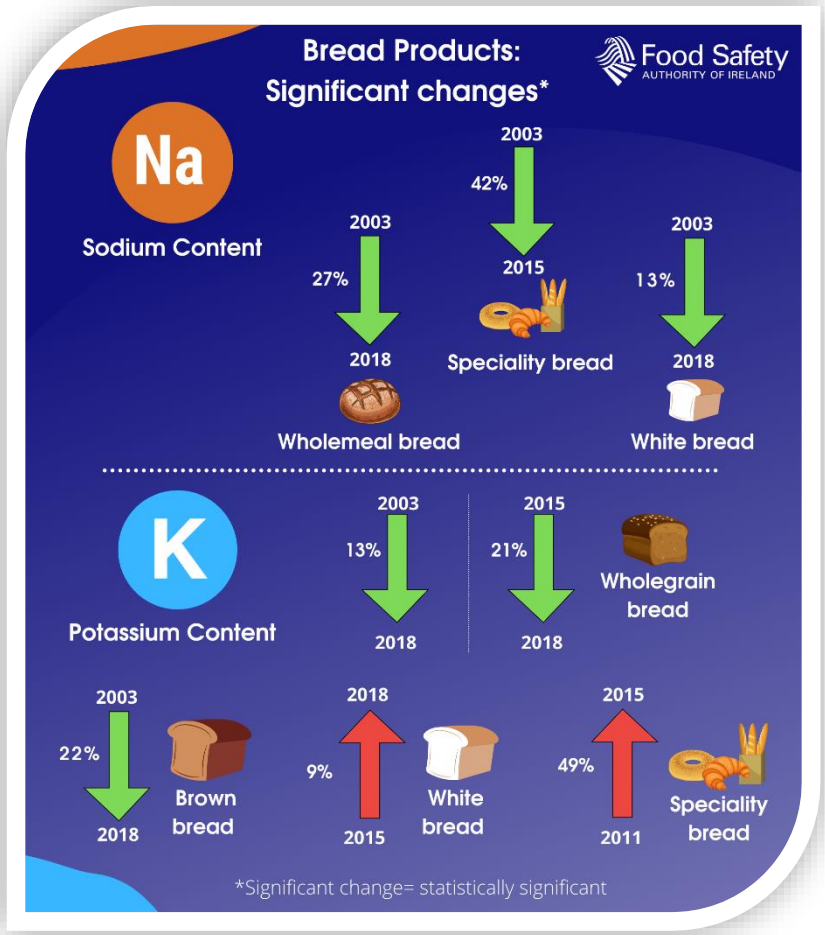
Table 12 Processed meats (potassium in mg/100g)

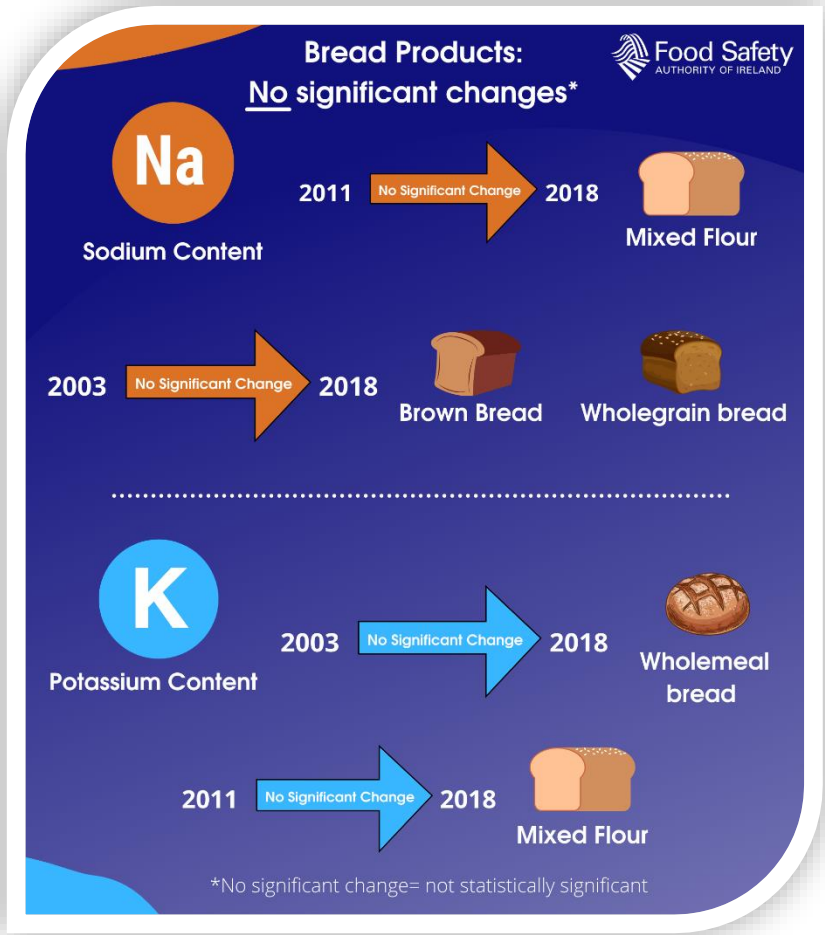
Category [a]	Mean potassium content Per year of survey						2004 vs 2019	% Potassium Content Change 2004 vs 2019	2012 vs 2015	% Potassium Content Change (2004 vs 2015)
	2004	2006	2009	2012	2015	2019				
Sausages [b]	161 (51)	162 (37)	139 (38)	144 (36)	158 (41)	196 (93)	NS	▲22	NS	▲25
Rashers [c]	281 (28)	302 (43)	281 (34)	302 (46)	318 (58)	345 (72)	0.002	▲23	NS	▲8
Pudding [d]	138 (41)	155 (33)	166 (33)	186 (30)	191 (36)	198 (32)	0.007	▲44	NS	▲4
Cooked ham [e]	334 (124)	310 (49)	338 (131)	313 (20)	341 (45)	334 (78)	NS	No change	NS	▼2
Continental meats	NT	NT	NT	NT	NT	408 (133)	NA	NA	NA	NA
Total samples	267 [f]	194 [g]	98 [h]	127	148	100	Overall total = 834			

Results presented as means (standard deviations). **a** Unless otherwise indicated all samples were analysed as sold i.e. raw. Potassium maybe present in some cured products as a result of the cure ingredient used e.g. Potassium Nitrate**; b** Includes both pork and beef sausages; **c** Rashers of bacon are cured pork and may come from any part of the pig and maybe smoked or unsmoked i.e. green. The majority of samples analysed in the FSAI surveys were back and streaky rashers. **d** Includes both white and black varieties of traditional Irish blood puddings**; e** Ham is traditionally the cured product taken from the upper leg and buttock of the pig. However, the majority of samples analysed in the FSAI surveys were pre-sliced reformed or restructured hams including varieties such as crumbed, smoked, honey roast, deli and traditional which were loose, modified atmosphere or vacuum packed**; f** Results for Cooked Sausages (n=12); Bratwurst Sausage (n=1); Cooked Gammon Ham (n=15); Cooked Pudding (n=23); Cooked Burgers (n=9); Vegetarian Burger (n=1); Cooked rashers (n=55); Savoury Steak (n=2); Hot Dogs in Brine (n=1); Canned Cooked Ham (n=3); Raw Burgers (n=71); Gammon Ham (n=4); Cooked Beef (n=2) are omitted from results shown above. However, all omitted results are available on request to the FSAI; **g** Results for Cooked Sausages (n=2); Polish Sausage (n=1); Turkey Sausage (n=1); Cooked Rashers (n=3); Cooked Burgers (n=3); Turkey Rashers (n=2); Raw Burgers (n=7); Gammon Ham (n=8); Cooked Poultry (n=13) Cooked Beef (n=6); Miscellaneous (n=7) are omitted from results shown above. However, all omitted results are available on request to the FSAI. **h** Results for Chicken Sausages (n=1); Cooked Burgers (n=1); Raw Burgers (n=9); Gammon Ham (n=20) are omitted from results shown above. However, all omitted results are available on request to the FSAI. **NA**, results not available; **NS**, not significant; **NT**, not tested.

Bread products

This section looks at the sodium and potassium content of bread products between 2003 and 2018.





- A significant reduction in sodium was observed for white and wholemeal bread (13% and 27% respectively) between 2003 and 2018.
- Between 2003 and 2015, a significant reduction in sodium was found for speciality breads (42%).
- No significant reduction in sodium content was observed for wholegrain breads.
- The potassium content of brown and wholegrain breads significantly reduced by 22% and 13% respectively.

Table 13 Bread products (sodium in mg/100g)

Category [a]	Mean sodium content Per year of survey						2003 to 2018 [i]	% Sodium content Change [i]	2015 to 2018 [i]	% Sodium Content Change [i]
	2003	2006	2011	2013	2015	2018				
White [b]	535 (71)	491 (81)	438 (84)	438 (33)	443 (89)	465 (99)	0.002	▼13	NS	▲5
Brown [c]	534 (133)	449 (45)	490 (78)	428 (57)	499 (59)	483 (84)	NS	▼9	NS	▼3
Wholemeal [d]	595 (140)	456 (61)	478 (101)	419 (69)	449 (70)	432 (86)	< 0.001	▼27	NS	▼4
Wholegrain [e]	588 (235)	417 (83)	457 (89)	NT	419 (20)	418 (73)	NS	▼29	NS	No change
Speciality [f]	634 (137)	NT	416 (77)	NT	370 (29)	NT	<0.001 (2003 vs 2015)	▼42 (2003 vs 2015)	NS (2011 vs 2015)	▼11 (2011 vs 2015)
Mixed flour [g]	NT	NT	408 (39)	393 (48)	399 (38)	386 (67)	NS *(2011 v 2018)*	▼5	NS	▼3
Unpackaged [h]	NT	NT	NT	NT	407 (102)	NT	NA	NA	NA	NA
Total samples	100	178	186	123	142	97	Overall total = 826 [j]			

Results presented as means (standard deviations). **a** 2003 samples taken September 2003; 2006 samples taken November 2005 to January 2006; 2010/11 samples taken July 2010, January 2011 and September 2011. Three samples representing three distinct batches and/or best-before dates were taken for 37 plant (industrial) bakery products in the 2011 survey. Data on the sodium content of soda breads is available on request for the years 2003, 2006 and 2011 (n=68). Breads include all varieties which include “soda” in their description including white and brown varieties. Some products did not include soda on the name/label but soda/sodium bicarbonate was included in ingredients, hence including it in this category. Data on the sodium content of bread rolls is available on request for the years 2003, 2006 and 2011 (n=57). Rolls include white and brown varieties of products such as Burger Buns, Baps, Baguettes, and Hot Dog Rolls etc; **b** White Breads include all varieties which include “white” in their main description such as Batch, Scotch Batch, Loaf,Barrell, Turnover, Bloomer, Pan, Chleb Malopolski, Kings Bread, Crusty and Cob, excluding soda breads; **c** Brown Breads include all varieties which include “brown” in their main description such as Batch, Loaf, Hi-Fibre, Wheatgerm, Wholegrain, Barrell, Multigrain, Crusty and Pan, excluding soda breads; **d** Wholemeal Breads include all varieties which include “wholemeal” in their description and/or include descriptions such as Stoneground, Hi-Fibre, Wheaten, Wheat, Wholewheat, Granary, excluding soda breads; **e** Wholegrain Breads include all varieties which include “wholegrain” in their description and/or include descriptions such as Multigrain, Healthy-Grain, Granary Malted, Granary, Cob, Rye, Scotch Batch, Malted, Rustic Grain, Nutty, Stoneground, Hi-Fibre, Kibbled, Wholewheat, Cracked Wheat, Scotch Batch, Multigrain and Paco Granary, excluding soda breads; **f** Speciality Breads include Ciabatta, Panini, Pitta Breads, Bagels, Corn Bread, Melba toast, Crumpets, Croissants and Procea; **g** Mixed Flour Breads are those varieties which mix white, wholemeal or brown flours together. Products in this category are described as "Best of Both", "50:50 White", “Two in One” or "Goodness of Both" etc; **h** Unpackaged breads include various loose breads, baguettes, rolls (seed, multigrain, diamond, pumpkin, cheese/onion etc), baps, ciabatta, Panini, whole unsliced loafs etc. Many of these breads are bought in a prepared raw state and baked in-store. Many symbol group retailers and supermarket chains now sell these bread products through in-store bakeries; **i** Unless otherwise stated; **j** Includes 68 soda bread samples and 57 bread roll samples. NA, results not available; NS, not significant; NT, not tested.

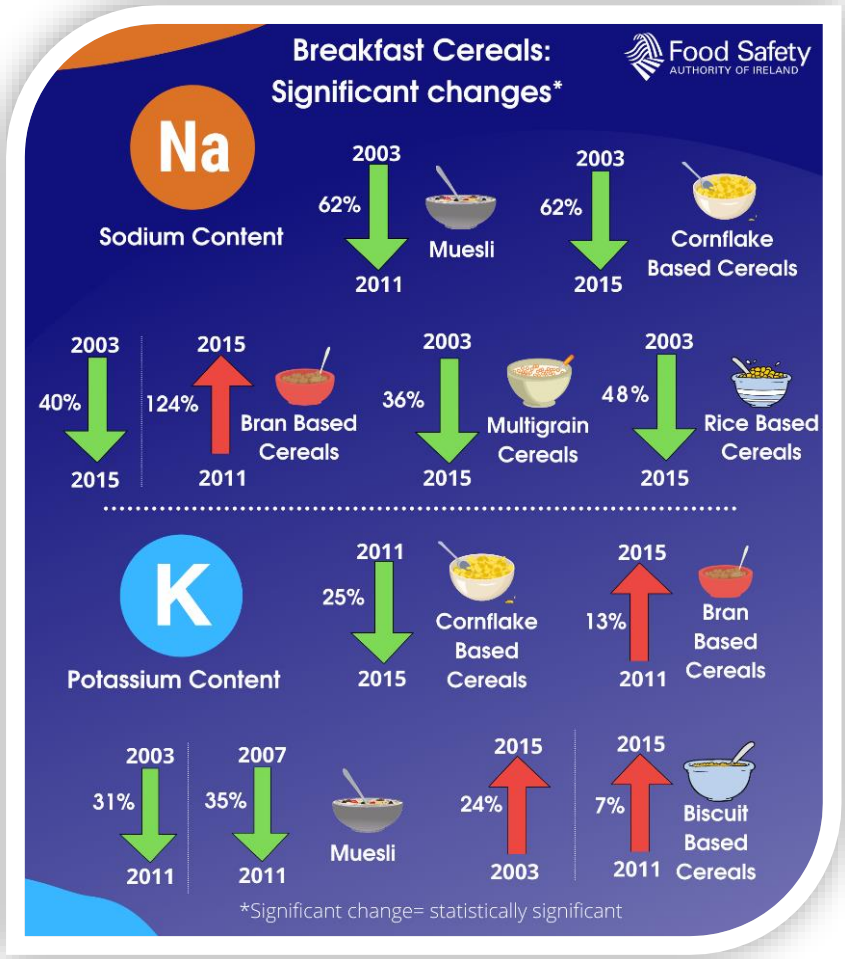
Table 14 Bread products (potassium in mg/100g)

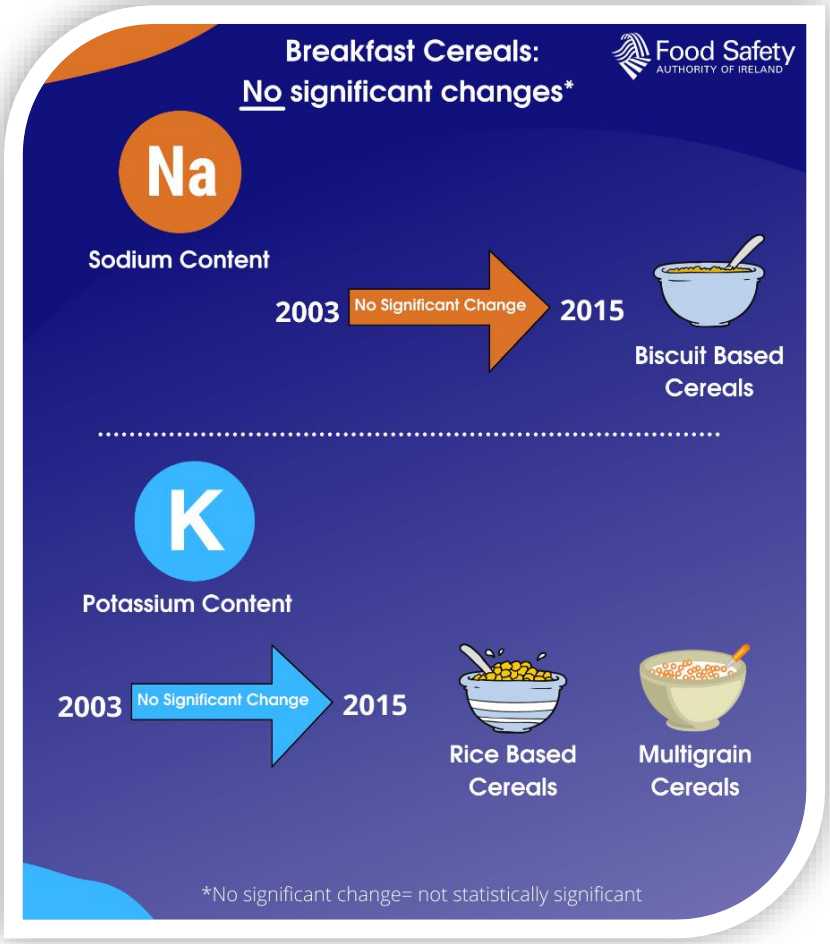
Category [a]	Mean Potassium Content Per Year of Survey						2003 to 2018 [i]	% Potassium Content Change (2003 to 2018) [i]	2015 to 2018 [i]	% Potassium Content Change (2003 to 2018) [i]
	2003	2006	2011	2013	2015	2018				
White [b]	141 (24)	137 (24)	134 (22)	119 (7)	128 (13)	139 (20)	NS	▼2	0.005	▲9
Brown [c]	251 (43)	212 (32)	209 (27)	186 (29)	204 (16)	194 (37)	0.001	▼22	NS	▼5
Wholemeal [d]	248 (37)	221(25)	229 (33)	432 (72)	242 (14)	240 (36)	NS	▼3	NS	▼1
Wholegrain [e]	232 (31)	196 (41)	198 (71)	NT	256 (23)	202 (40)	0.043	▼13	<0.001	▼21
Speciality [f]	156 (55)	NT	131 (24)	NT	196 (53)	NT	NS	▲25 (2003 vs 2015)	0.050 (2011 vs 2015)	▲49 (2011 vs 2015)
Mixed Flour [g]	NT	NT	167 (24)	400 (32)	172 (36)	162 (21)	NS *(2011 v 2018)*	▼3	NS	▼1
Unpackaged [h]	NT	NT	NT	NT	149 (42)	NT	NA	NA	NA	NA
Total Samples	100	178	186	123	142	97	Overall Total = 826 [j]			

Results presented as means (standard deviations)**. a** 2003 samples taken September 2003; 2006 samples taken November 2005 to January 2006; 2010/11 samples taken July 2010, January 2011 and September 2011. Three samples representing three distinct batches and/or best-before dates were taken for 37 plant (industrial) bakery products in the 2011 survey. Data on the sodium content of soda breads is available on request for the years 2003, 2006 and 2011 (n=68). Soda Breads include all varieties which include “soda” in their description including white and brown varieties. Some products did not include soda on the name/label but soda/sodium bicarbonate was included in ingredients, hence including it in this category. Data on the sodium content of bread rolls is available on request for the years 2003, 2006 and 2011 (n=57). Rolls include white and brown varieties of products such as Burger Buns, Baps, Baguettes, and Hot Dog Rolls etc; **b** White Breads include all varieties which include “white” in their main description such as Batch, Scotch Batch, Loaf, Barrell, Turnover, Bloomer, Pan, Chleb Malopolski, Kings Bread, Crusty and Cob, excluding soda breads; **c** Brown Breads include all varieties which include “brown” in their main description such as Batch, Loaf, Hi-Fibre, Wheatgerm, Wholegrain, Barrell, Multigrain, Crusty and Pan, excluding soda breads; **d** Wholemeal Breads include all varieties which include “wholemeal” in their description and/or include descriptions such as Stoneground, Hi-Fibre, Wheaten, Wheat, Wholewheat, Granary, excluding soda breads; **e** Wholegrain Breads include all varieties which include “wholegrain” in their description and/or include descriptions such as Multigrain, Healthy-Grain, Granary Malted, Granary, Cob, Rye, Scotch Batch, Malted, Rustic Grain, Nutty, Stoneground, Hi-Fibre, Kibbled, Wholewheat, Cracked Wheat, Scotch Batch, Multigrain and Paco Granary, excluding soda breads; **f** Speciality Breads include Ciabatta, Panini, Pitta Breads, Bagels, Corn Bread, Melba toast, Crumpets, Croissants and Procea; **g** Mixed Flour Breads are those varieties which mix white, wholemeal or brown flours together. Products in this category are described as "Best of Both", "50:50 White", “Two in One” or "Goodness of Both" etc; **h** Unpackaged breads include various loose breads, baguettes, rolls (seed, multigrain, diamond, pumpkin, cheese/onion etc), baps, ciabatta, Panini, whole unsliced loafs etc. Many of these breads are bought in a prepared raw state and baked in-store. Many symbol group retailers and supermarket chains now sell these bread products through in-store bakeries; **i** Unless otherwise stated; **j** Includes 68 soda bread samples and 57 bread roll samples. NA, results not available; NS, not significant; NT, not tested.

Breakfast cereals

This section looks at the sodium and potassium content of breakfast cereals between 2003 and 2015.





- Comparing 2003 and 2015, a significant reduction in sodium content was observed for all categories with the exception of biscuit based cereals. no significant change in sodium content was observed comparing 2011 and 2015 with the exception of bran based cereals (increased 124%).
- A significant increase in potassium content was observed for biscuit based, muesli and all other cereal products (no added salt/low salt) (33%, 42% and 38% respectively).
- In all other cereal products, a significant reduction in potassium content was observed (38%).

Table 15 Breakfast cereals (sodium in mg/100g)

Category	Mean sodium content Per year of survey				2003 vs 2015 [i]	% Sodium content change (2003 vs 2015) [i]	2011 vs 2015 [i]	% Sodium content change (2011 vs 2015) [i]
	2003	2007	2011 [h]	2015				
Rice based cereals [a]	555 (168)	535 (215)	301 (79)	290 (90)	< 0.001	▼48	NS	▼4
Bran based cereals [b]	544 (174)	409 (156)	146 (176)	327 (65)	0.003	▼40	<0.001	▲124
Cornflake based cereals [c]	718 (213)	551 (101)	309 (117)	276 (74)	< 0.001	▼62	NS	▼11
Biscuit based cereals [d]	275 (141)	268 (48)	218 (39)	241(49)	NS	▼12	NS	▲10
Multigrain cereals [e]	534 (170)	348 (137)	277 (104)	343 (84)	0.015	▼36	NS	▲24
Muesli [f]	119 (121)	55 (67)	45 (60)	NT	0.03	▼62	NS	▼19
All other cereal products [g] ***(no added salt/low salt)***	5 (3)	26 (29)	32 (29)	NT	< 0.001 (2003 vs 2011)	▲481 (2003 vs 2011)	NS (2007 vs 2011)	▲22 (2007 vs 2011)
Total samples	88	119	330	150	Overall total = 687			

Results presented as means (standard deviations)**. a** Includes products which are rice based and/or have "Rice" in their main product description. For the year 2003 this category also includes one corn based product. This category may also include some adult/health cereals which are based on rice; **b** Bran is the outer layer of cereals including corn (maize), rice, oats, wheat, barley etc. and is typically produced as a by-product of milling This category includes products which have "Bran" in their main description and other related cereals which contain bran such as Fruit & Fibre cereals 2003 (n = 3/9); 2007 (n = 7/20); 2011 (n=15/39) representing 5 individual products; **c** Includes products which have "Cornflake" or "Flake" in their main description and includes varieties such as Frosted, Honey & Nut etc. Excludes those cornflake based products which have “Bran” in their description; **d** Includes products which are predominately wheat/oat based and biscuit shaped; **e** Includes products which have more than one cereal grain in their ingredient listing. This category may also include some cereal which contains other ingredients such as nuts and fruit; **f** Includes products which have "Muesli" in their product description and includes varieties with added fruit, nuts and no-added sugar/sweetener; **g** Includes all cereal products which have no added salt i.e. results obtained reflect natural content and variation or levels of salt below 120mg/100g = Low Sodium/Salt Regulation 1924/2006. This category includes samples of porridge which are also described as Wheatbran, Oatbran, Oatflakes, Oatlets, Oatmeal, Oat Cereal, Pinhead etc. Other products in this category include various muesli, crunch cluster, wheat puff, Wholewheat, rice and bran based cereals; **h** The majority of products surveyed in 2011 were sampled three times with three distinct batches and/or best-before dates to provide more representative sampling of products. Total number of samples taken in this survey number was 330. 14/330 of the samples were porridge products. Of the remaining 316 samples 98 products were sampled 3 or more times (3*98 =294 samples); 9 products were sampled 2 times (9*2= 18 samples) and 2 products were sampled just once (2*1=2). Therefore a total of 109 individual products were sampled in the 2011 survey excluding porridge products; **i** Unless otherwise stated. NS, not significant; NT, not tested.

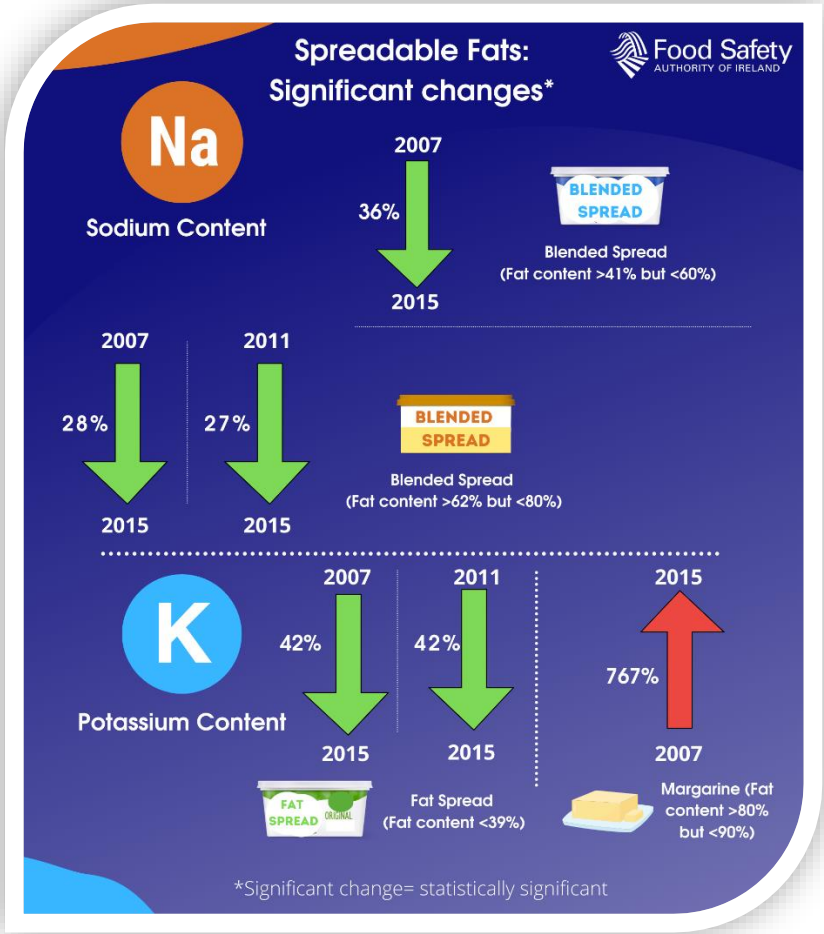
Table 16 Breakfast cereals (potassium in mg/100g)

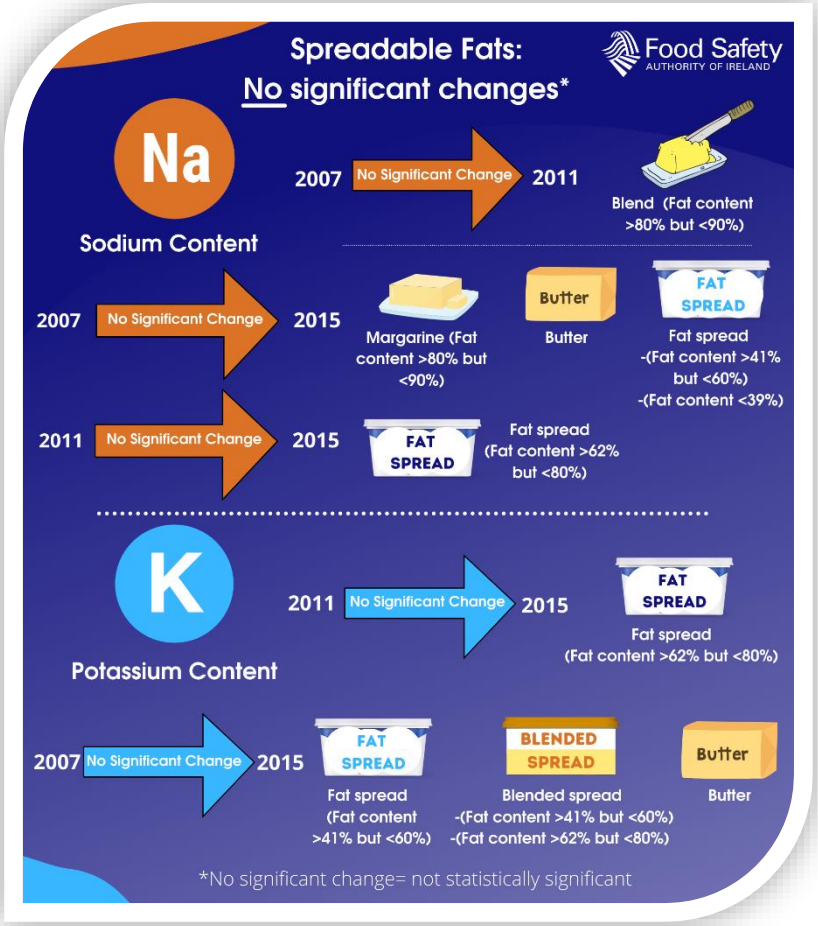
Category	Mean content Potassium per year of survey				2003 vs 2015 [i]	% Potassium content Change (2003 vs 2015) [i]	2011 vs 2015 [i]	% Potassium Content Change (2011 vs 2015) [i]
	2003	2007	2011 [h]	2015				
Rice based cereals [a]	182 (73)	161 (58)	195 (75)	181 (72)	NS	▼1	NS	▼7
Bran based cereals [b]	522 (135)	538 (175)	489 (132)	552 (110)	NS	▲6	0.012	▲13
Cornflake based cereals [c]	110 (61)	91 (31)	152 (104)	115 (90)	NS	▲5	0.038	▼25
Biscuit based cereals [d]	333 (62)	360 (25)	385 (41)	412 (25)	0.009	▲24	0.010	▲7
Multigrain cereals [e]	237 (63)	274 (79)	307 (108)	285 (120)	Ns	▲20	NS	▼7
Muesli [f]	479 (140)	507 (104)	331 (130)	NT	0.002 (2003 vs 2011)	▼31 (2003 vs 2011)	<0.001 (2007 vs 2011)	▼35 (2007 vs 2011)
All other cereal products [g] ***(no added salt/low salt)***	465 (256)	398 (189)	287 (87)	NT	0.010 (2003 vs 2011)	▼38 (2003 vs 2011)	0.016 (2007 vs 2011)	▼28 (2007 vs 2011)
Total samples	88	119	330	150	Overall total = 687			

Results presented as means (standard deviations)**. a**Includes products which are rice based and/or have "Rice" in their main product description. For the year 2003 this category also includes one corn based product. This category may also include some adult/health cereals which are based on rice; **b** Bran is the outer layer of cereals including corn (maize), rice, oats, wheat, barley etc. and is typically produced as a by-product of milling This category includes products which have "Bran" in their main description and other related cereals which contain bran such as Fruit & Fibre cereals **2003** ***(n = 3/9)***; **2007** ***(n = 7/20)*****; 2011** ***(n=15/39)*** *representing 5 individual products*; **c** Includes products which have "Cornflake" or "Flake" in their main description and includes varieties such as Frosted, Honey & Nut etc. Excludes those cornflake based products which have “Bran” in their description; **d** Includes products which are predominately wheat/oat based and biscuit shaped; **e** Includes products which have more than one cereal grain in their ingredient listing. This category may also include some cereal which contains other ingredients such as nuts and fruit; **f** Includes products which have "Muesli" in their product description and includes varieties with added fruit, nuts and no-added sugar/sweetener; **g** Includes all cereal products which have no added salt *i.e. results obtained reflect natural content and variation* or levels of salt below 120mg/100g = Low Sodium/Salt Regulation 1924/2006. This category includes samples of porridge which are also described as Wheatbran, Oatbran, Oatflakes, Oatlets, Oatmeal, Oat Cereal, Pinhead etc. Other products in this category include various muesli, crunch cluster, wheat puff, Wholewheat, rice and bran based cereals; **h** The majority of products surveyed in 2011 were sampled three times with three distinct batches and/or best-before dates to provide more representative sampling of products. Total number of samples taken in this survey number was 330. 14/330 of the samples were porridge products. Of the remaining 316 samples 98 products were sampled 3 or more times *(3*98 =294 samples)*; 9 products were sampled 2 times *(9*2= 18 samples)* and 2 products were sampled just once *(2*1=2)*. Therefore a total of 109 individual products were sampled in the 2011 survey excluding porridge products; **i** Unless otherwise stated.

Spreadable fats

This section looks at the sodium and potassium content of spreadable fats between 2007 and 2015.





- No change in sodium content was observed for the majority of spreadable fats.
- A significant reduction in sodium content was found for blended spreads (fat content >62% but <80%).
- In terms of potassium content, no change was observed for the majority of the sub-categories of spreadable fats. Exceptions to this include fat spreads (fat content <39%).

Table 17 Spreadable fats (sodium in mg/100g)

Category [a]	Mean content Sodium per year of survey			2007 vs 2015 [p]	% Sodium content Change (2007 vs 2015) [p]	2011 vs 2015	% Sodium Content Change (2011 vs 2015) [p]
	2007	2011	2015				
Butter [b-c]	631 (234)	518 (124)	588 (120)	NS	▼7	NS	▲14
Half-fat butter [d]	590 (127)	450 (14)	650	NA	NA	NA	NA
Margarine [e] ***(fat content >80% but <90%)*** [f]	313 (191)	560 (138)	501 (82)	NS	▲60	NS	▼11
Fat spread [e] ***(fat content >62% but <80%)*** [g]	1150	441 (107)	525 (126)	NA	NA	NS	▲19
Fat spread [e] ***(fat content >41% but <60%)*** [h]	537 (108)	478 (103)	498 (104)	NS	▼7	NS	▲4
Fat spread [e] ***(fat content <39%)*** [i]	502 (160)	459 (59)	509 (116)	NS	▲2	NS	▲11
Blend [j] ***(fat content >80% but <90%)*** [k]	390 (28)	393 (107)	NT	Ns (2007 vs 2011)	▲1 (2007 vs 2011)	NA	NA
Blended spread [j] ***(fat content >62% but <80%)*** [l]	632 (48)	618 (26)	452 (33)	<0.001	▼28	< 0.001	▼27
Blended spread [j] ***(fat content >41% but <60%)*** [m]	635 (35)	540	406 (36)	0.018	▼36	NA	NA
Total samples	72	90 [n]	90 [o]	Overall total = 252			

Results presented as means (standard deviations). a Categories are based on sale descriptions outlined in Annex XV of Council Regulation (EC) No 1234/2007 establishing a common organisation of agricultural markets and on specific provisions for certain agricultural products (Single CMO Regulation); b Products with a milk-fat content of not less than 80% but less than 90%, a maximum water content of 16% and a maximum dry non-fat milk-material content of 2%; c Includes one flavoured butter (Garlic & Herb) and excludes 3 unsalted butters for 2007 results; d Includes one product described as a low-fat butter with a 40% fat content. The terms 'low-fat' or 'light' may be used for products referred to in the Annex XV of Council Regulation (EC) No 1234/2007 with a fat content of 41% or less. The term reduced-fat and the terms low-fat or light may, however, replace respectively the terms three quarter-fat or half-fat used in the Annex; e Products in the form of a solid, malleable emulsion, principally of the water-in-oil type, derived from solid and/or liquid vegetable and/or animal fats suitable for human consumption, with a milk-fat content of not more than 3% or the fat content; f Products obtained from vegetable and/or animal fats with a fat content of not less than 80% but less than 90%; g Products obtained from vegetable and/or animal fats with a fat content of more than 62% but less than 80%; h Products obtained from vegetable and/or animal fats with a fat content of more than 41% but less than 60%; i Products obtained from vegetable and/or animal fats with a fat content of less than 39%; j Products in the form of a solid, malleable emulsion principally of the water-in-oil type, derived from solid and/or liquid vegetable and/or animals fats suitable for human consumption, with a milk-fat content of between 10 % and 80 % of the fat content; k Products obtained from a mixture of vegetable and/or animal fats with a fat content of not less than 80% but less than 90%; l Products obtained from a mixture of vegetable and/or animal fats with more than 62% but less than 80%; m Products obtained from a mixture of vegetable and/or animal fats with a fat content of more than 41% but less than 60%; n 2011 samples comprise 90 individual samples representing 31 individual products; o Includes 3 samples of beef dripping but not included in values presented; p Unless otherwise stated. Link to Guidance on Spreadable Fats: Guidance Note No. 30: The Use of the Term ‘Butter’ in the Labelling and Advertising of Fat Spreads
NA, results not available; NS, not significant; NT, not tested.

Table 18 Spreadable fats (potassium in mg/100g)

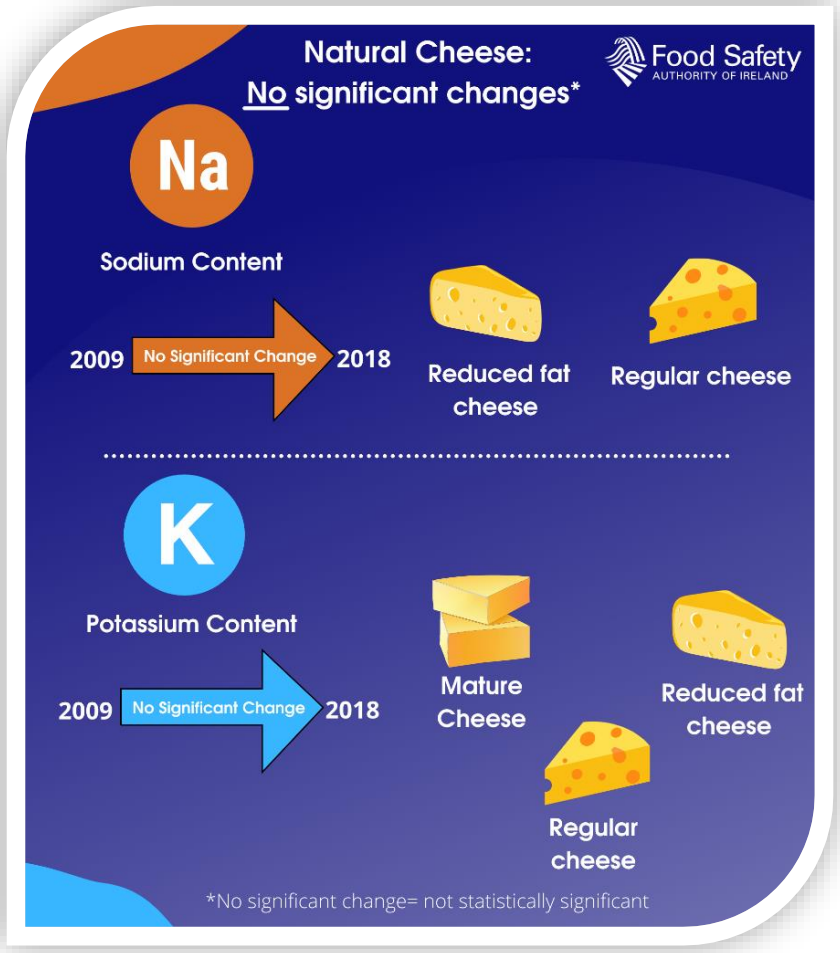
Category [a]	Mean potassium content per year of survey			2007 vs 2015 [p]	% Potassium content Change (2007 vs 2015) [p]	2011 vs 2015 [p]	% Potassium content Change (2011 vs 2015) [p]
	2007	2011	2015				
Butter [b-c]	29 (17)	50 (74)	21 (8)	NS	▼28	NS	▼58
Half-fat butter [d]	32 (39)	30 (0)	NT	NA	NA	NA	NA
Margarine [e] ***(fat content >80% but <90%)*** [f]	5 (0)	52 (86)	43 (20)	<0.001	▲767	NS	▼16
Fat spread [e] ***(fat content >62% but <80%)*** [g]	40	29 (14)	24 (15)	NA	NA	NS	▼19 (2011 vs 2015)
Fat spread [e] ***(fat content >41% but <60%)*** [h]	40 (20)	34 (16)	34 (15)	NS	▼13	NS	▲1
Fat spread [e] ***(fat content <39%)*** [i]	51 (26)	51 (24)	29 (20)	0.012	▼42	0.010	▼42
Blend [j] ***(fat content >80% but <90%)*** [k]	20 (0)	20 (0)	NT	NA	NA	NA	NA
Blended spread [j] ***(fat content >62% but <80%)*** [l]	42 (27)	58 (54)	28 (22)	NS	▼35	NS	▼53
Blended spread [j] ***(fat content >41% but <60%)*** [m]	55 (21)	60	28 (11)	NS	▼49	NA	NA
Total samples	72	90 [n]	90 [o]	Overall total = 252			

Results presented as means (standard deviations)**. a** Categories are based on sale descriptions outlined in Annex XV of Council Regulation (EC) No 1234/2007 establishing a common organisation of agricultural markets and on specific provisions for certain agricultural products (Single CMO Regulation). Link to Spreadable Fats Legislation; **b** Products with a milk-fat content of not less than 80% but less than 90%, a maximum water content of 16% and a maximum dry non-fat milk-material content of 2%; **c** Includes one flavoured butter (Garlic & Herb) and excludes 3 unsalted butters for 2007 results; **d** Includes one product described as a low-fat butter with a 40% fat content. The terms 'low-fat' or 'light' may be used for products referred to in the Annex XV of Council Regulation (EC) No 1234/2007 with a fat content of 41% or less. The term reduced-fat and the terms low-fat or light may, however, replace respectively the terms three quarter-fat or half-fat used in the Annex; **e** Products in the form of a solid, malleable emulsion, principally of the water-in-oil type, derived from solid and/or liquid vegetable and/or animal fats suitable for human consumption, with a milk-fat content of not more than 3% or the fat content; **f** Products obtained from vegetable and/or animal fats with a fat content of not less than 80% but less than 90%; **g** Products obtained from vegetable and/or animal fats with a fat content of more than 62% but less than 80%; **h** Products obtained from vegetable and/or animal fats with a fat content of more than 41% but less than 60%; **i** Products obtained from vegetable and/or animal fats with a fat content of less than 39%; **j** Products in the form of a solid, malleable emulsion principally of the water-in-oil type, derived from solid and/or liquid vegetable and/or animals fats suitable for human consumption, with a milk-fat content of between 10 % and 80 % of the fat content; **k** Products obtained from a mixture of vegetable and/or animal fats with a fat content of not less than 80% but less than 90%; **l** Products obtained from a mixture of vegetable and/or animal fats with more than 62% but less than 80%; **m** Products obtained from a mixture of vegetable and/or animal fats with a fat content of more than 41% but less than 60%; **n** 2011 samples comprise 90 individual samples representing 31 individual products; **o** Includes 3 samples of beef dripping but not included in values presented; **p** 2007 to 2011 values. **Guidance on Spreadable Fats:** Guidance Note No. 30: The Use of the Term 'Butter' in the Labelling and Advertising of Fat Spreads

NA, results not available; NS, not significant; NT, not tested.

Natural cheeses

This section looks at the sodium and potassium content of natural cheeses between 2009 and 2018.



- The sodium content of mature cheese significantly reduced by 6% comparing 2009 and 2018.
- No changes in the sodium content of regular or reduced fat cheese were observed.
- In terms of potassium content, no significant changes for any of the sub-categories were observed.

Table 19 Natural cheeses (sodium in mg/100g)

Category	Mean sodium content per year of survey			2009 vs 2018	% sodium content Change (2009 vs 2018)	2012 vs 2018	% sodium content Change (2012 vs 2018)
	2009	2012	2018				
Regular [b]	731 (236)	641 (61)	633 (62)	NS	▼13	NS	▼1
Mature [c]	667 (64)	651 (42)	625 (51)	0.031	▼6	0.030	▼4
Reduced fat [d]	756 (287)	637 (95)	652 (69)	NS	▼14	NS	▲2
Total samples	34	56	93 [e]	Overall total = 183			

Results presented as means (standard deviations)**. a** Samples are predominately cheddar or cheddar based cheese products which are the most commonly consumed cheeses in Ireland**; b** Regular includes both white and red/coloured cheddars which are labelled as smooth, creamy, medium or mild; **c** Mature includes both white and red/coloured cheddars which are mature, extra mature or vintage; **d** Reduced fat includes both white and red/coloured cheddars or cheddar based cheese products which are labelled light, reduced, half-fat etc; **e** Total samples comprise Regular = 33; Mature = 45 and Reduced Fat = 15. NS, not significant.

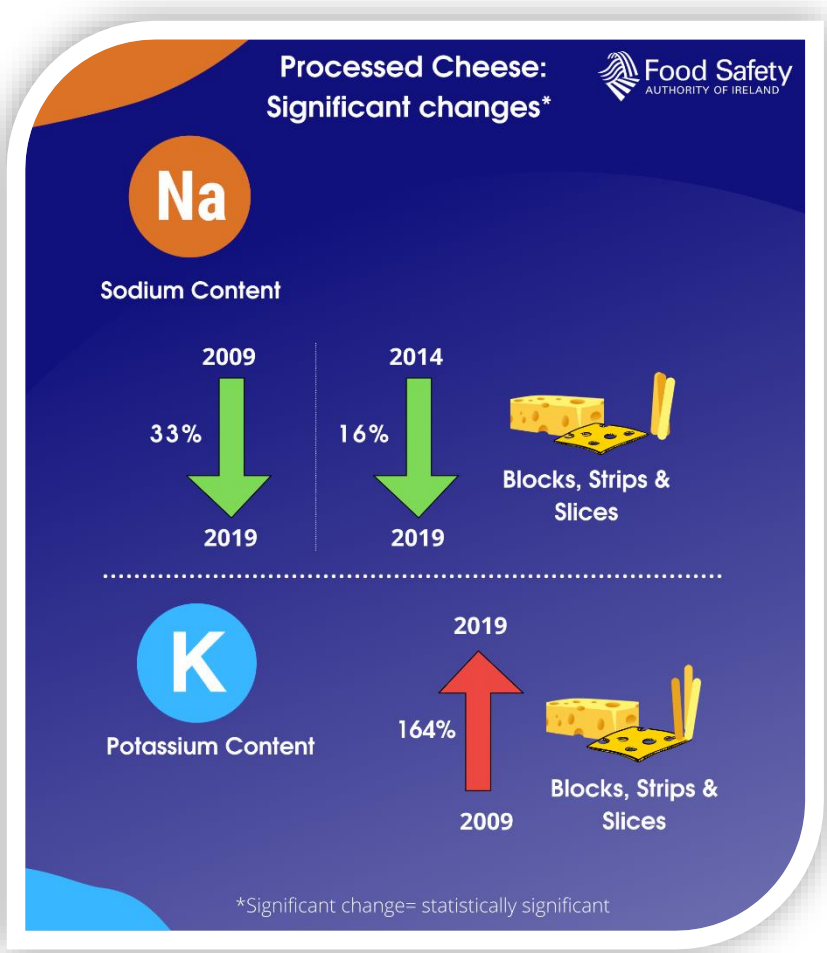
Table 20 Natural cheese (potassium in mg/100g)

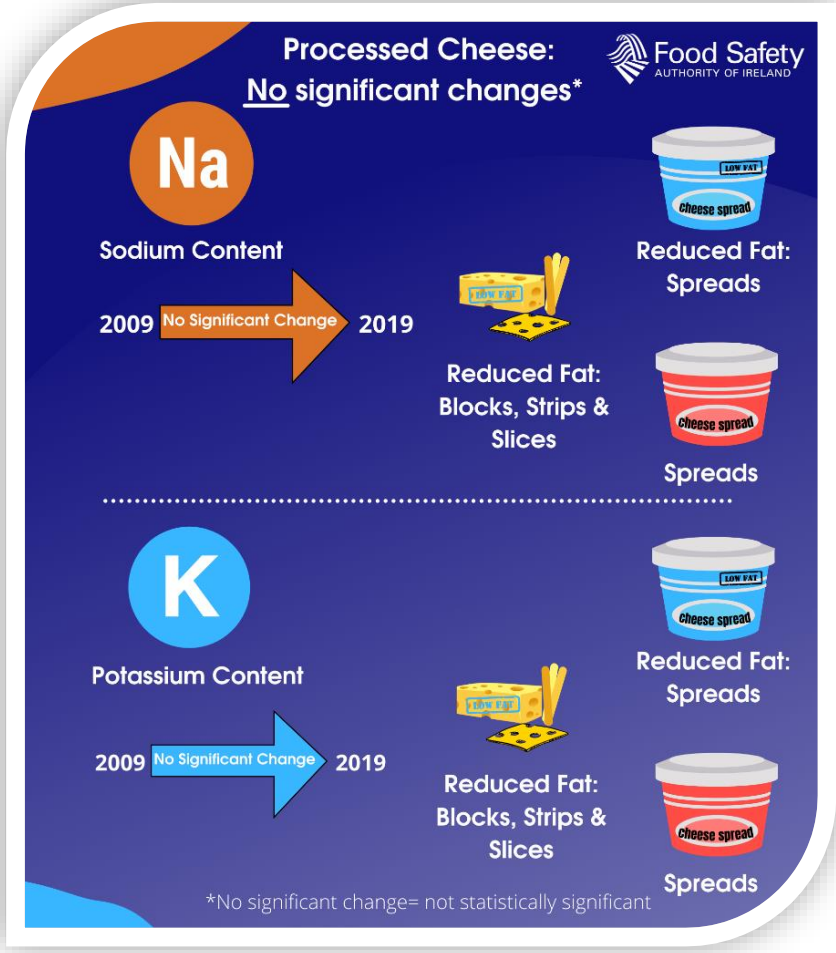
Category [a]	Mean potassium content per year of survey			2009 vs 2018	% Potassium content change (2009 vs 2018)	2012 vs 2018	% Potassium content Change (2012 vs 2018)
	2009	2012	2018				
Regular [b]	96 (40)	76 (7)	80 (7)	NS	▼16	NA	▲5
Mature [c]	83 (6)	79 (7)	80 (5)	NS	▼4	NS	▲2
Reduced fat [d]	90 (13)	73 (6)	83 (6)	NS	▼8	NS	▲13
Total samples	34	56	93 [e]	Overall total = 183			

Results presented as means (standard deviations)**. a** Samples are predominately cheddar or cheddar based cheese products which are the most commonly consumed cheeses in Ireland; **b** Regular includes both white and red/coloured cheddars which are labelled as smooth, creamy, medium or mild; **c** Mature includes both white and red/coloured cheddars which are mature, extra mature or vintage; **d** Reduced fat includes both white and red/coloured cheddars or cheddar based cheese products which are labelled light, reduced, half-fat etc; **e** Total samples comprise Regular = 33; Mature = 45 and Reduced Fat = 1. NS, not significant..

Processed Cheeses

This section looks at the sodium and potassium content of processed cheeses between 2009 and 2019.





- A significant reduction in sodium content was observed for blocks, strips & slices between 2009 and 2019 (33%).
- No reductions in sodium content were found for any of the other sub-categories of processed cheese.
- A significant increase in potassium content was observed for blocks, strips & slices between 2009 and 2019 (164%).
- No changes in potassium content were found for any of the other sub-categories of processed cheese.

Table 21 Processed cheeses (sodium in mg/100g)

Category	Mean sodium content per year of survey			2009 vs 2019	% Sodium content Change (2009 vs 2019)	2014 to 2019	% Sodium content Change (2014 vs 2019)
	2009	2014 [f]	2019				
Blocks, strips & slices [a-b]	1095 (330)	867 (261)	732 (219)	0.001	▼33	0.007	▼16
Reduced fat: blocks, strips & slices [a-b]	1298 (219)	836 (224)	942 (341)	NS	▼27	NS	▲13
Spreads [c]	626 (392)	535 (252)	495 (294)	NS	▼21	NS	▼7
Reduced fat: spreads [d]	612 (310)	376 (238)	396 (223)	NS	▼35	NS	▲5
Snack packs [e]	NT	NT	591 (205)	NA	NA	NS	NA
Total samples	36	173	107	Overall total = 316			

Results presented as means (standard deviations)**. a** Includes white and red/coloured cheese slices individually wrapped or not; **b** Includes white and red/coloured cheese slices which are light, reduced or half-fat, individually wrapped or not; **c** Includes white and red/coloured cheese spreads which individually portioned or not and cheese spreads with added ingredients such as herbs, vegetables and meats and spreads used as cooking sauces; **d** Includes white and red/coloured cheese spreads which are light, reduced or half-fat, individually wrapped or not and reduced fat cheese spreads with added ingredients such as herbs, vegetables and meats and spreads used as cooking sauces; **e** Snack Packs sub-category include products of crackers/bread sticks with a portion of cheese included often aimed at children. Only the processed cheese portion of the product was analysed for sodium content; **f** Taken between October and December 2014, comprising 82 branded and 91 private label samples. NA, results not available; NS, not significant.

Table 22 Processed cheeses (potassium in mg/100g)

Category	Mean potassium content per year of survey			2009 vs 2019	% Sodium content Change (2009 vs 2019)	2014 vs 2019	% Sodium content Change (2014 vs 2019)
	2009	2014 [f]	2019				
Blocks, strips & slices [a-b]	88 (34)	162 (187)	232 (255)	0.001	▲164	NS	▲44
Reduced fat: blocks, strips & slices [a-b]	150 (70)	255 (221)	148 (78)	NS	▼1	NS	▼42
Spreads [c]	164 (76)	206 (143)	162 (67)	NS	▼1	NS	▼21
Reduced fat: spreads [d]	192 (37)	181 (98)	238 (196)	NS	▲24	NS	▲32
Snack packs [e]	NT	NT	316 (189)	NA	NA	NA	NA
Total samples	36	173	107	Overall total = 316			

Results presented as means (standard deviations)**. a** Includes white and red/coloured cheese slices individually wrapped or not; **b** Includes white and red/coloured cheese slices which are light, reduced or half-fat, individually wrapped or not; **c** Includes white and red/coloured cheese spreads which individually portioned or not and cheese spreads with added ingredients such as herbs, vegetables and meats and spreads used as cooking sauces; **d** Includes white and red/coloured cheese spreads which are light, reduced or half-fat, individually wrapped or not and reduced fat cheese spreads with added ingredients such as herbs, vegetables and meats and spreads used as cooking sauces; **e** Snack Packs sub-category include products of crackers/bread sticks with a portion of cheese included often aimed at children. Only the processed cheese portion of the product was analysed for sodium content; **f** Taken between October and December 2014, comprising 82 branded and 91 private label sample. NA, results not available; NS, not significant.

Condiments

- As Condiments were sampled for the first time in 2017, no changes in sodium and potassium contents can be investigated until the next sampling point.

Table 23 Condiments (Sodium in mg/100g)

Category [a]	Sodium content per year of survey
	2017 [f]
Ketchup [b]	681 (294)
Salad cream [c]	581 (78)
Mayonnaise [d]	544 (125)
Brown sauce [e]	444 (325)
Total samples	157

Results presented as means (standard deviations)**. a** All products sampled and analysed in triplicate [exception one branded tomato ketchup product only available as a single sample]; **b** Six branded products produced by four manufacturers and twelve private label products from six retailers; **c** Two branded products produced by one manufacturer and seven private label products from four retailers; **d** Four branded products produced by two manufacturers and twelve private label products from six retailers; **e** Four branded products produced by three manufacturers and six private label products from five retailers; **f** Samples taken in August 2017. NA, results not available.

Table 24 Condiments (potassium in mg/100g)

Category [a]	Potassium content per year of survey
	2017 [f]
Ketchup [b]	386 (135)
Salad cream [c]	27 (8)
Mayonnaise [d]	29 (17)
Brown sauce [e]	144 (94)
Total samples	157

[a] All products sampled and analysed in triplicate [exception one branded tomato ketchup product only available as a single sample]
[b] Six branded products produced by four manufacturers and twelve private label products from six retailers.
[c] Two branded products produced by one manufacturer and seven private label products from four retailers
[d] Four branded products produced by two manufacturers and twelve private label products from six retailers
[e] Four branded products produced by three manufacturers and six private label products from five retailers
[f] Samples taken in August 2017

Results from out-of-home sources of salt sampling

Pre-packaged sandwiches

Table 25 Pre-packaged sandwiches (sodium and potassium in mg/100g)

Category	Sodium content per year of survey	Potassium content per year of survey
	2020	**2020**
Blt	492 (66)	199 (44)
Ham & cheese	541 (56)	186 (35)
Total samples	20	

Results presented as means (standard deviations). Blt bacon, lettuce & tomato

Fried foods

Table 26 Fried foods (sodium and potassium in mg/100g)

Category	Sodium content per year of survey	Potassium content per year of survey
	2020	**2020**
Fried foods[a]	168 (91)	428 (119)
Total samples	8	

Results presented as means (standard deviations). [a] selection of fried foods that were collected as part of a separate FSAI survey were analysed for sodium and potassium content per 100g. Samples included deep-fried foods including fish, battered sausage, battered burget and breaded chicken goujons.

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