The contribution of processed pork meat products to total salt intake in the diet

*Beulah Pretorius

Department of Animal and Wildlife Science

Institute of Food Nutrition And Well-Being

University of Pretoria

Pretoria

South Africa

Tel: +27 12 348 6649

Fax: +27 12 361 2333

E-mail: beulah.pretorius@up.ac.za

Hettie C Schönfeldt

Department of Animal and Wildlife Science

Institute of Food Nutrition and Well-Being

University of Pretoria

Pretoria

South Africa

E-mail: hettie.schonfeldt@up.ac.za

*Corresponding author

Research Highlights

- Reported portion sizes are smaller than indicated serving sizes
- The reported intake of processed meat products per day is low
- Processed pork meat products contribute to < 2% of the total dietary sodium intake
- Recent food intake data (frequency and amount) on processed meat products is necessary

Abstract

Consumption of processed meats is reported to be the second largest contributor to total dietary sodium intake. This study aims to describe the contribution of commonly consumed processed pork products to total salt intake. A large variation was found in the sodium content between similar products. Sodium content (mg/100 g) for bacon ranged from 558 to 1570, russians from 762 to 1403, viennas from 480 to 1340 and ham from 696 to 1360 respectively. When converting sodium content from 100 g to serving size, different products contributed the most sodium to the diet. A serving size of brawn (125 g uncooked) will contribute on average 983 mg sodium to total sodium intake. Pork bangers will contribute the lowest amount of sodium (~400 mg) to the diet (~4 % of RDI). Reported daily intake are smaller than indicated serving sizes and the contribution of processed meat to sodium intake can be predicted to be lesser than expected.

Keywords: sodium, salt, processed meat

1. Background

It is widely accepted that reducing salt consumption will lead to lower blood pressure, which will in turn be beneficial to one's health (Webster, Dunford, Hawkes, & Neal, 2011). As well as preventing 7 400 deaths due to cardiovascular diseases per year in South Africa, the prevention of non-fatal strokes will also relieve pressure on the overburdened health system. This amounts to a total annual saving of at least R300 million (40 million USD) due to the prevention of non-fatal strokes, excluding household costs, such as loss of income (Bertram, Steyn, Wentzel-Viljoen, Tollman & Hofman, 2012).

The World Health Organisation (WHO) has been supporting the development of national salt reduction strategies since 2007, and has established networks that partner with regional organisations world-wide. Salt reduction strategies were also adopted in the revised national Food Based Dietary Guidelines, "Use salt and foods high in salt sparingly": a food-based dietary guideline for South Africa" (Wentzel-Viljoen, Steyn, Ketterer & Charlton, 2013).

The average salt intake in South African (SA) adults, at 8.1 g/day, is almost double than the 4-6 g/day recommended by the World Health Organization (Bertram, et al. 2012). This has prompted the South African Department of Health to take a legislative route towards lowering salt content in South African foods by publishing the salt reduction regulations

(R214) in March 2013. A two-phase step-change process was chosen to get consumer palates used to the taste of processed products with less salt. The first targets need to be reached by June 2016 and the second targets by June 2019. Among food products targeted for reformulation by the South African National Department of Health are bread, breakfast cereals, ready-to-eat savoury snacks and potato crisps, fat spreads and butter, processed meat and raw processed meat sausages, soup, gravy and sauce powder and stock cubes, powders, granules and jellies (Department of Health, 2013).

In a previous study, meat and meat products (such as processed meat products) is reported to be the second largest contributor to total reported dietary sodium intake (20.3 % to 23.6 %) in South Africa (Charlton, et al. 2005). According to the South African National Standard (SANS 885:2011 edition 3) processed meat is defined as "meat that has undergone any action that substantially altered its original state (including, but not limited to, heating, smoking, curing, fermenting, maturing, drying marinating, extraction or extrusion or any combination of all these processes), but excludes raw processed meat" (SABS, 2011).

1.1. Salt vs Sodium

Although the two terms "sodium" and "salt" are often used interchangeably, it is different substances. The vast majority of sodium in the diet is provided by sodium chloride (Wentzel-Viljoen, et al. 2013). By weight, sodium chloride (NaCl), the chemical name for salt, is composed of 40 % sodium and 60 % chloride. To calculate the salt content of food (in g), the sodium value (in g) should be multiplied by 2.5. One (1) gram sodium chloride equals 17.1 millimolar amounts of sodium or 393.4 milligram of sodium. One teaspoon of salt weighs approximately five grams and contains about 2,000 mg of sodium (International Food Industry Council, 2010). Therefore, the recommended dietary guideline of 4-6 g of salt translates into 1 600 – 2 400 mg sodium per day.

1.2. The role of sodium in meat and meat products

Over the years, salt has served many diverse purposes and roles beyond its use as seasoning in foods. One of salt's most recognised uses has been in preservation and microbiological safety of meat products. As a preservative salt reduces the water activity and prevents the growth of food poisoning and spoilage organisms (International Food Industry Council, 2010). Reducing salt can also lead to a greening effect which would not be acceptable to consumers (Grant, McCurdy & Osborne, 1988).

Salt is important to both the taste and aroma of meat products for several reasons. Firstly sodium binds to protein receptors and conveys the salty taste that consumers are familiar with. Secondly sodium enhances some of the natural flavours present in meat such as savoury and meaty notes. In terms of the flavour, it could be argued that the main challenge in reducing salt in meat products is not in fact the reduction in saltiness itself but the loss of impact on enhancing the meaty and savoury flavours in the product (Food and Drink Federation (FDF) and British Retail Consortium (BRC), 2012).

A further technical challenge is that salt also interacts with meat proteins, in particular the myofibrillar proteins which are then extracted and enabled to bind water which is retained within the meat product. Therefore reducing salt in meat products may lead to products that are different texturally as well as in terms of their flavour profile (Food and Drink Federation (FDF) and British Retail Consortium (BRC), 2012).

A reduction in salt levels therefore may lead to a reduction in shelf-life and consumer acceptability and therefore a potential increase in food waste.

Technical feasibility to reduce salt is often stated as a barrier by the industry. A survey on the current salt levels in pork products would provide insight into this issue by quantifying the variability in the salt levels of similar products produced by different companies. This study also aimed to provide information on the contribution of processed pork products to total salt intake in the diet.

2. Materials and Methods

To estimate the contribution of a food group or a subclass (such as processed pork meat products) to the daily dietary sodium intake, it is necessary to firstly determine the sodium content of the food product. However, only measuring sodium content in milligrams per 100 g (mg/100 g) does not take into account either amount (daily serving size) or the likely frequency of consumption.

2.1. Food Composition Data

Data analysis of the sodium content of processed pork meat products was performed using the Condensed Food Composition Tables of South Africa (Wolmarans, Danster, Dalton, Rossouw, & Schönfeldt, 2010), analysed data provided by the South African Meat Processors Association (SAMPA) and nutrition labels from processed products in selected supermarkets. Analyses were conducted on 151 processed pork meat products divided into the 9 product classes containing processed pork meat as indicated in the South African National Standard for processed meat products, SANS 885:2011 (SABS, 2011). Processed meat is defined as meat that has undergone any action that substantially altered its original state (including, but not limited to, heating, smoking, curing, fermenting, maturing, drying, marinating(surface application), extraction or extrusion or any combination of all these processes), but excludes raw processed meat. The average, minimum and maximum of the sodium content were calculated for each category.

2.2. Food Intake Data

The frequency of consumption of different sodium containing foods is vastly unequal, resulting in some foods with high sodium content that are infrequently consumed, being only minor contributors of sodium to the diet, and vice versa. Therefore, the total sodium load, weighted by frequency of consumption, ought to be taken into account. Electronic and manual searching of peer reviewed literature, as well as electronic data sets of unpublished studies done on the dietary intake of processed pork meat products were employed. Studies performed on large populations using scientifically accredited methods were included.

- Report on South African food consumption studies undertaken amongst different population groups (1983 – 2000): average intakes of foods most commonly consumed. Secondary data-analysis was conducted on existing dietary databases (raw data) obtained from surveys undertaken in South Africa between 1983 and 2000 (Nel & Steyn, 2002). The National Food Consumption Survey (NFCS) served as a framework for compiling data on children since this was a national representative survey of 1-9 year-old (NFCS, 1999). For extrapolating data national dietary intake data for adults the following databases were utilised: Lebowa Study; Dikgale Study; Black Risk Factor Study (BRISK); Transition, Health and Urbanisation Study

(THUSA); THUSA Bana Study; First Year Female Student (FYFS) Project; Weight and Risk Factor Study (WRFS); and the Coronary Risk Factor Study (CORIS).

- The ongoing Birth-To-Twenty (Bt20) Study at the University of the Witwatersrand which developed from the Birth-To-Ten Study (Bt10) initiated in 1990 (Pedro, MacKeowen & Norris 2008) (Feeley, Pettifor & Norris, 2009).
- The PURE Study (**P**rospective **U**rban and **R**ural **E**pidemiology study) which is coordinated from the Population Health Research Institute, Ontario, Canada to track the development of chronic diseases of lifestyle in urban and rural subjects in approximately 20 developing countries. One of the South African legs of this study was conducted in the North West Province (PURE-SA-NWP) in 2005 (Kruger, 2005).
- The study of the food intake of South African Indian population conducted in Kwa-Zulu Natal (MacIntyre, Naicker, Venter, & Ellis 2010). This study provides the first insight into food intake of the Indian population since 1999.

3. Results and Discussion

3.1. Food Composition Data

Several studies, based on the sodium content, noted that the food groups highest in sodium content were sauces, spreads and processed meats (DeSimone, Beauchamp, Drewnowski, Johnson, 2013).

Processed pork products included under the salt reduction regulations (R214) (Department of Health, 2013) and SANS 885:2011 (SABS, 2011) with target dates and maximum sodium levels are summarised in Table 1. Although biltong, kasseler, bacon, salami, cervelat, cabanossi, mettwurst and teewurst have a high sodium content, these products are excluded under the current regulations.

Sodium occurs naturally in meat up to a concentration of between 40-60 mg/100 g in raw pork and between 60-80 mg/100 g in raw mutton or beef (Wolmarans, et al., 2010). In processed meat and meat products, the sodium content is much higher with the highest levels traditionally in cured meat products and sausages (Kloss, Meyer, Graeve, & Vetter, 2015). An analysis of the available sodium content data of processed pork meat products on the South African market is presented in Table 2 and Figure 1.

Table 1: Categories of processed pork products that will be affected by the salt reduction regulations (R214, published in March 2013) with target dates and maximum sodium concentration levels.

Product Class	Examples per class	Target dates and maximum total sodium per 100g foodstuff	
		30 June 2016	30 June 2019
Class 1	Gammons, pastrami, cooked silverside, roast beef (cured), country ham, edible whole muscle offal i.e. pickled tongue	[#]Not included under regulation R214	
Class 2	Roast pork, roast beef (uncured), carpaccio	[#]Not included under regulation R214	
Class 3	Uncured biltong	[#]Not included under regulation R214	
Class 4	Kasseler, bacon	[#]Not included under regulation R214	
Class 5	Cured biltong, smoked beef, koppa, pancetta	[#]Not included under regulation R214	
Class 6	Emulsion products (*ie.* viennas, polonies, frankfurters, meat loaves, russians, cheese grillers and any combination of showpiece and meat emulsion mixtures e.g. an olive loaf)	850 mg	650 mg
Class 7	Bangers, burgers	950 mg	850 mg
Class 8	Dried wors, biltong wheels or discs	[#]Not included under regulation R214	
Class 9	Salami, cervelat, cabanossi, mettwurst, teewurst	[#]Not included under regulation R214	
Class 10	Blanched pork sausages, uncured chicken viennas, polonies, fully cooked burgers	950 mg	850 mg
Class 11	Reformed nuggets, schnitzels	950 mg	850 mg
Class 12	Reformed hams, chicken, turkey rolls	850 mg	650 mg
Class 13	Reformed bacon, reformed kasseler chops	[#]Not included under regulation R214	
Class 14	Unspecified	850 mg	650 mg
Class 15	Meat portions, fingers, nuggets, strips, products including vegetables, fruit, sauce or a combination thereof	[#]Not included under regulation R214	

[#]These high-sodium products, such as biltong and bacon, were excluded from the regulations, as they are not widely consumed in large amounts.

Table 2: Average sodium content (mg/100g) of processed pork meat products.

Product Class (SANS 885:2011)	**Description of processed pork meat products**		Avg	Min	Max
***Class 1 (n = 2)**	Gammon	Gammon	711	711	711
	Country ham	Country ham	878	878	878
***Class 4 (n = 17)**	Bacon	Weigh less smoked	715	614	815
		Weigh less lean back	1354	1167	1540
		Crispy smoked	1570	1570	1570
		Back	1018	738	1160
		Shoulder	931	558	1350
		Streaky	943	632	1118
Class 6 (n = 83) **850 mg Na - 30 Jun 2016** **650 mg Na - 30 Jun 2019**	Brawn	Curry brawn	1022	786	1257
		Oxford brawn	1022	786	1257
	Frankfurters	Traditional	1074	962	1140
		Smoked	735	735	735
		German	1034	1034	1034
	Grillers	Cheese	1075	910	1240
	Loaves	Ham & Tongue	900	900	900
		Bacon roll	825	825	825
		Chilli loaf	904	904	904
	Polony	French	1045	870	1233
		Garlic	952	864	1040
		Special garlic	1100	1100	1100
		Liver spread	803	746	860
		Polony	999	903	1100
		Meat	900	900	900
		Vienna	900	900	900
	Russions	Cheese	928	886	970
		Traditional	1044	762	1403
		Smoked	1048	762	1257
	Vienna	Red	969	824	1149
		Weigh less red	480	480	480
		Mini / cocktail cheese	872	825	918
		German	745	745	745
		Mini / Cocktail	921	746	1096
		Smoked	1090	784	1340
Class 7 (n = 3) **950 mg Na - 30 Jun 2016** **850 mg Na - 30 Jun 2019**	Bangers	Weigh less herbed pork bangers	555	426	684
	Burgers	Pre-cooked marinated rib burgers	784	784	784

***Class 9 (n = 4)**	Salami	Traditional	1695	1640	1750
		German	1469	1469	1469
		Peppered	1620	1620	1620
Class 10 (n = 8) **800 mg Na - 30 Jun 2016** **600 mg Na - 30 Jun 2019**	Sausages	Mini bacon	811	730	891
		Mini pork	664	664	664
		Country	840	840	840
		Pork	674	664	684
		Breakfast	824	824	824
		Bockwurst	878	878	878
Class 11 (n = 1) **800 mg Na - 30 Jun 2016** **600 mg Na - 30 Jun 2019**	Schnitzels	Pork Schnitzels	344	344	344
Class 12 (n = 23) **850 mg Na - 30 Jun 2014** **650mg Na - 30 Jun 2019**	Ham	Picnic ham	1141	1000	1282
		Mini Ham	1011	992	1030
		Chargrilled ham	726	696	756
		Lean smoked ham	866	866	866
		Smoked ham	1112	934	1290
		Gypsy ham	918	918	918
		Cooked ham (250g pack)	1061	610	1360
		Chopped ham roll	1037	905	1240
		Luncheon meat	1074	854	1293
		Sandwich ham	1023	801	1171
Class 14 (n = 4) **850 mg Na - 30 Jun 2014** **650 mg Na - 30 Jun 2019**	Ribs	Pre-cooked marinated loin	656	632	680
		Pre-cooked marinated spare ribs	519	511	526

*exempted from current salt reduction regulations R214

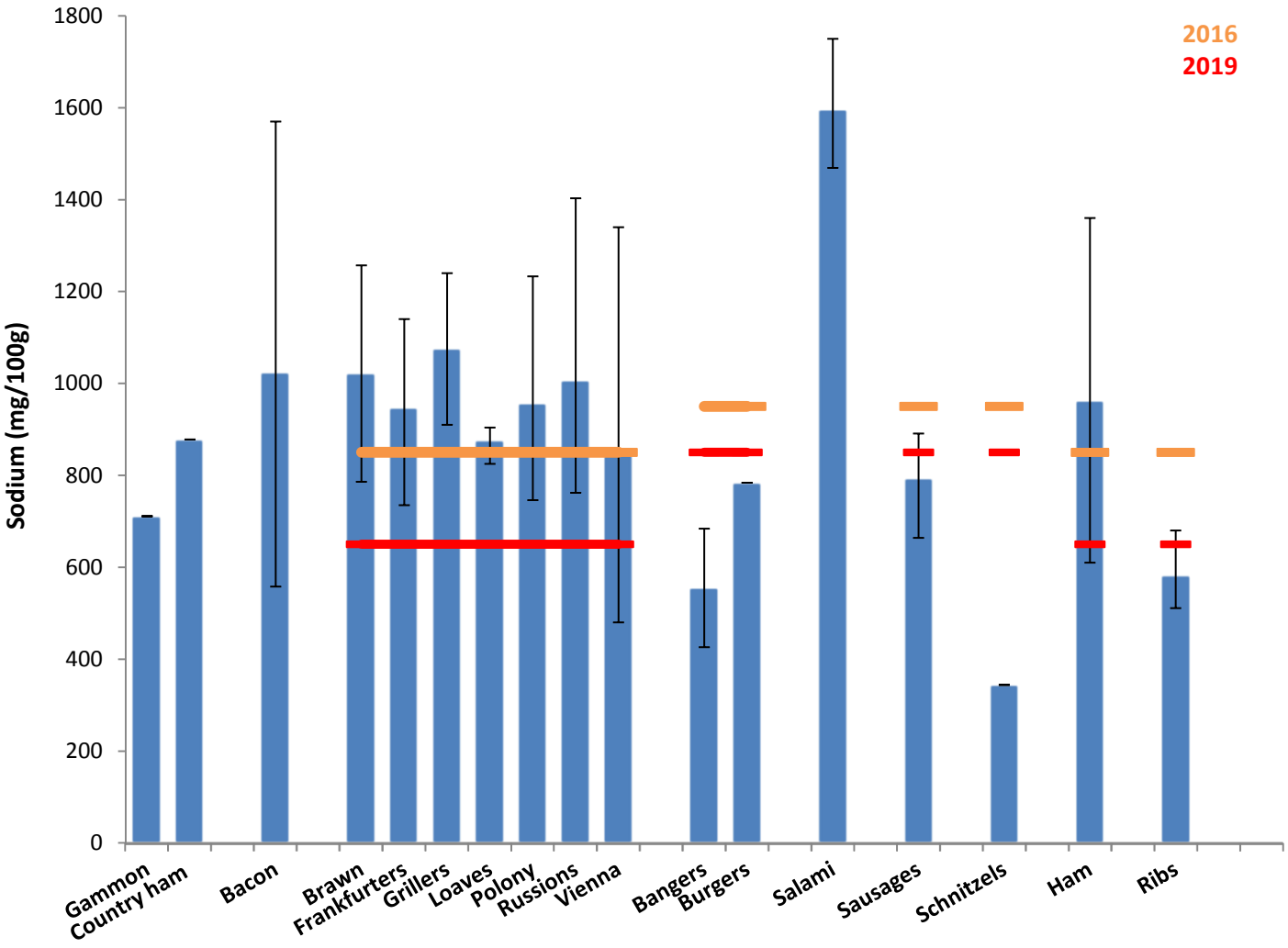

Figure 1: Sodium content (mg/100 g) of different uncooked processed meat products. The orange line indicates the 2016 sodium reduction target and the red line indicates the 2019 target.

(Class 1: Gammon, Country ham; Class 4: Bacon; Class 6: Brawn, Frankfurters, Grillers, Loaves, Polony, Russions, Vienna; Class 7: Bangers, Burgers; Class 9: Salami; Class 10: Sausages; Class 11: Schnitzels; Class 12: Ham; Class 14: Ribs)

Based on sodium content per 100 g, food products that were highest in sodium were as follows: salami, grillers, bacon and brawn (Figure 1), with both salami (class 9) and bacon (class 4) not included in the products which had to comply with the reduced sodium levels. There is a large variation in the sodium content between similar processed pork meat products available to the consumer. For example, sodium content (mg/100 g) for bacon ranged from 558 to 1 570, polony from 746 to 1 233, russians from 762 to 1 403, viennas from 480 to 1 340 and ham from 696 to 1 360 respectively. This variation in sodium content might be due to different analytical methods used by the different laboratories, but it can also be an indication that it is possible for manufacturers to decrease the sodium content of the products by employing different production strategies, such as using salt substitutes, salt flakes or using high pressure technology.

However, many such foods are typically consumed in serving sizes well below 100 g. The proposed reference amounts for single serving sizes is based on reference amounts customarily consumed, and these vary from 15 g for cooked bacon (54 g uncooked) to 60 g cooked patties (100 g uncooked).

3.2. Food Intake Data - Estimating sodium intake

Currently in South Africa there is no specific requirement for the size of each “serving” of processed meat products. The Food Labelling regulations R146 of 2010 (Department of Health, 2010) indicated that “*the mass or volume of a single serving shall be determined by the manufacturer and shall be an appropriate serving size for a single serving which would not encourage consumers to consume "supersize" servings which might result in an undesirable increase of their total energy intake that could contribute to unhealthy weight gain”.* However, the size of “one serving” of different food products of the same type may vary and the serving size declared on the products may not reflect the actual amount most consumers would usually consume. Some consumers may find the information provided confusing or misleading. Therefore, guidelines on serving size would be useful to assist the trade in preparing nutrition labels, as well as to facilitate consumers to better understand and utilise the information provided.

For the purpose of this study the reference amounts for single serving sizes as proposed in Guideline 11 of the new draft regulations relating to the labelling and advertising of foodstuffs R429 (as indicated in Table 3) was used to determine sodium intake for processed meat (Department of Health, 2014).

Table 3: Reference amounts for single serving sizes (Department of Health, 2014)

Product Class (SANS 885:2011)	**Description of processed pork meat products**		**Reference amount / serving**
***Class 1**	Gammon	Gammon	85 g raw 55 g cooked
	Country ham	Country ham	85 g raw 55 g cooked
***Class 4**	Bacon	Weigh less smoked Weigh less lean back Crispy smoked Back Shoulder Streaky Rashers	54 g uncooked 15 g cooked
Class 6 **850 mg Na- 30 Jun 2016** **650 mg Na- 30 Jun 2019**	Brawn	Curry brawn, Oxford brawn	125 g raw 100 g cooked
	Frankfurters	Traditional Smoked German	75 g uncooked 55 g cooked
	Grillers	Cheese	75 g uncooked 55 g cooked
	Loaves	Ham & Tongue Bacon roll Chilli loaf	75 g uncooked 55 g cooked
	Polony	French Garlic Special garlic Liver spread Polony Meat Vienna	75 g uncooked 55 g cooked
	Russions	Cheese Traditional Smoked	75 g uncooked 55 g cooked
	Vienna	Red Weigh less red Mini / cocktail cheese German Mini / Cocktail Smoked	75 g uncooked 55 g cooked
Class 7	Bangers	Weigh less herbed pork bangers	75 g uncooked

950 mg Na - 30 Jun 2016 **850 mg Na - 30 Jun 2019**			55 g cooked
	Burgers	Pre-cooked marinated rib burgers	100 g raw 60 g cooked
***Class 9**	Salami	Traditional German Peppered	30 g
Class 10 **800 mg Na - 30 Jun 2016** **600 mg Na - 30 Jun 2019**	Sausages	Mini bacon Mini pork Country Pork Breakfast Bockwurst	75 g uncooked 55 g cooked
Class 11 **800 mg Na - 30 Jun 2016** **600 mg Na - 30 Jun 2019**	Schnitzels	Pork schnitzel	125 g raw 100 g cooked
Class 12 **850 mg Na - 30 Jun 2014** **650mg Na - 30 Jun 2019**	Ham	Picnic ham Mini Ham Chargrilled ham Lean smoked ham Smoked ham Gypsy ham Cooked ham (250g pack) Cooked ham (125g pack) Chopped ham roll Luncheon meat Sandwich ham	75 g uncooked 55 g cooked
Class 14 **850 mg Na - 30 Jun 2014** **650 mg Na - 30 Jun 2019**	Ribs	Pre-cooked marinated loin Pre-cooked marinated spare ribs	125 g raw 100 g cooked

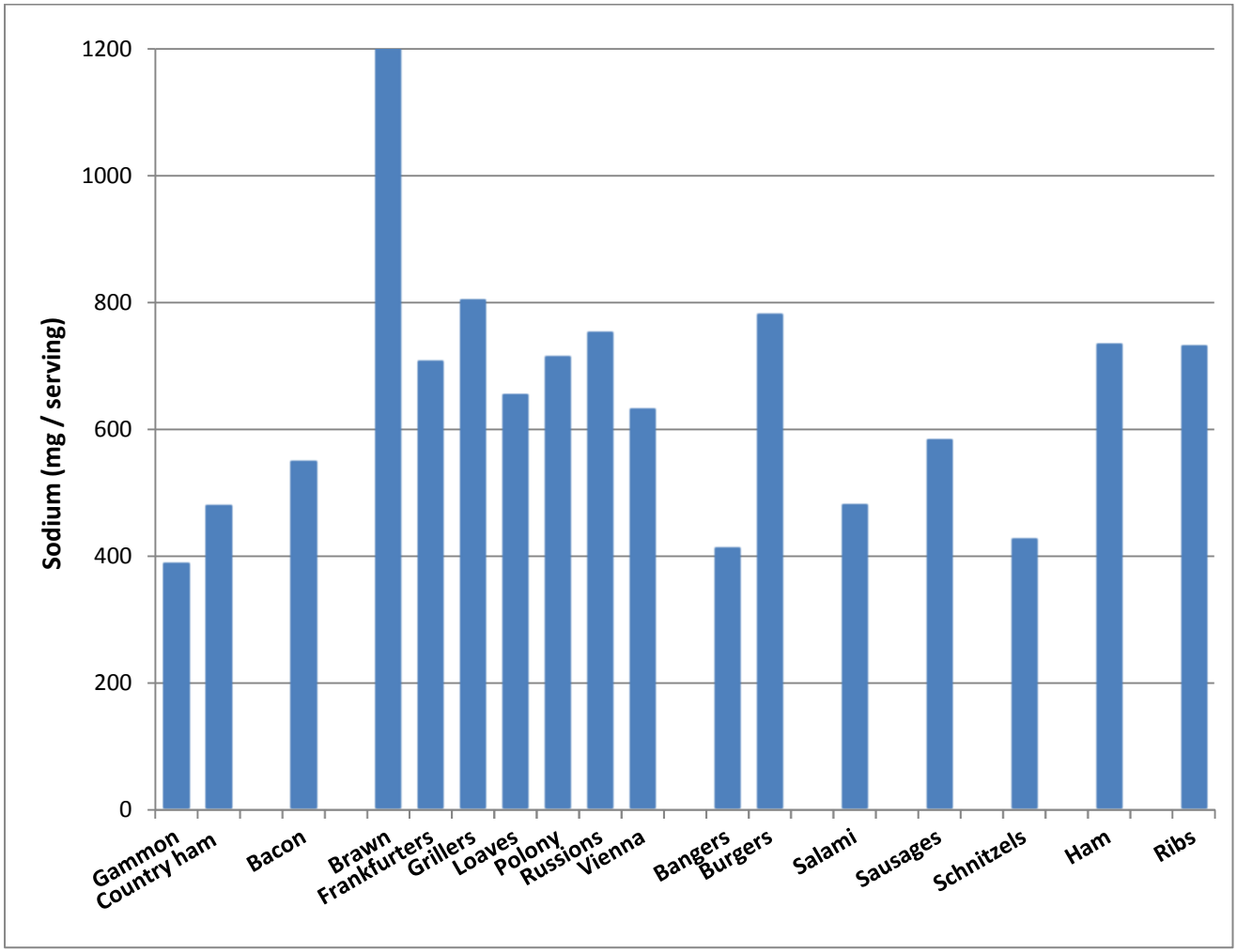

Figure 2: Sodium content (mg) per serving size of different processed pork meat products

(Class 1: Gammon, Country ham; Class 4: Bacon; Class 6: Brawn, Frankfurters, Grillers, Loaves, Polony, Russions, Vienna; Class 7: Bangers, Burgers; Class 9: Salami; Class 10: Sausages; Class 11: Schnitzels; Class 12: Ham; Class 14: Ribs)

When sodium content was converted from 100 g product to serving size in grams as proposed by the new draft regulations relating to the labelling and advertising of foodstuffs R429 (Department of Health 2014), different products contribute highest to sodium intake in the diet (Figure 2). A serving size of brawn (125 g uncooked) will contribute on average 1 277 mg sodium to total sodium intake (~50 % of recommended dietary guideline), while grillers and burger patties will contribute on average 800 mg sodium (~30 % of recommended dietary guideline). Pork bangers and gammon will contribute the lowest amount of sodium (~400 mg) to the diet (~17 % of recommended dietary guideline).

The frequency of consumption of different sodium containing foods is vastly unequal, resulting in some foods with high sodium content that are infrequently consumed, being only minor contributors of sodium to the diet, and vice versa. Therefore, the total sodium load, weighted by frequency of consumption, ought to be taken into account. Unfortunately there is a scarcity of food frequency data (Van Heerden & Schönfeldt, 2011) particularly as related to processed meat products. If available, data may be outdated, but mostly it does not differentiate between different processed meat products.

The baseline data obtained from one of the South African legs of the large cross sectional prospective urban and rural epidemiology (PURE) study conducted in approximately 20 developing countries, probably represents the most representative data produced on actual meat, fish and egg intake by black urban and rural South African adults in the past decade. The reported intake of meat products (sausages, ham, corned meat, viennas, frankfurters, giblets, tongue) in the PURE Study population is low with only about 62-63 % of subjects consuming between 10 and 21 g per day. The average serving for adult men and women were reported to be 17.7 g and 18.2 g respectively (Van Heerden, Schönfeldt & Hall 2012). In the 'Birth-to-Twenty' cohort it is reported that adolescents living in Soweto and Johannesburg ate one serving of a variety of processed meats daily due to their reliance on fast-food (Feeley, Pettifor & Norris, 2009).

In a study investigation the food intake of the South African Indian population since 1999 in Kwa-Zulu Natal, it was found that among Indian women, the most frequently eaten processed meats appear to be polony (57.6 %), grilled mutton sausage (92.8 %), crumbed or breaded fried chicken patties (54 %) and commercial curried mutton pies (30.2 %). Biltong and bacon are not eaten frequently. The reported serving sizes are relatively small varying from about 9 to 29 g per day in those subjects who eat processed meat products (Van Heerden, Schönfeldt & Hall, 2012).

The abovementioned studies report an average serving size of 19 g (between 9 and 29 g). Polony has an average sodium content of 718 mg/100 g. This translates into a sodium contribution of < 1 % to the recommended dietary guideline for sodium intake (2 400 mg).

4. Conclusion

Salt has proven functionality in processed meat products, resulting in manufacturers' reluctance to reduce the sodium content in fear of decreasing shelf-life and consumer

preference. However, wide variations were seen in sodium content among different brands of the same product. This variation in sodium levels within products suggests that sodium levels can be reduced without compromising taste and shelf life. This might also be due to analytical variation related to method differences used by the different manufacturers and laboratories.

The availability of national intake data of processed meat products, and specifically processed pork products is very limiting. Reported daily intake is smaller than indicated serving sizes. Therefore, the contribution of processed meat to sodium intake can be predicted to be lesser than expected through previous reports (Charlton et al. 2005). To validate this finding more and up to date food intake data (frequency and amount) with specific emphasise on processed meat products is necessary to determine the actual sodium load provided by specific food products in the diet.

The involvement of food industry specialists and consumers in salt reduction and targeting food categories from which most consumers obtain their salt is vital to ensuring the long-term integration of reduced sodium foods into the diet. While, food scientists have a range of ingredient solutions to help reduce salt and other sodium-containing ingredients, finding the right mix takes time and effort. Discretionary salt intake is high and can be as high as 40 % of total salt intake (Wentzel-Viljoen et al. 2013). Increasing consumer awareness of salt remains important to also decrease discretionary salt intake.

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