

ORIGINAL RESEARCH

Added sugar and sodium levels in New Zealand processed fruit and vegetable-based products

Lynne CHEPULIS¹, Nadine EVERSON², Amanda HEAPY³ and Gael MEARNs⁴

¹Waikato Medical Research Centre, University of Waikato, Hamilton, Departments of ²Nursing and ³Health and Social Services, Toi Ohomai Institute of Technology, Rotorua and ⁴School of Clinical Sciences, Auckland University of Technology, Auckland, New Zealand

Abstract

Aim: Fruit and vegetables are strongly promoted because of the nutrients they provide; many processed products contain added sugar and sodium. The present study aims to quantify the sugar and sodium content of pre-packaged fruit and vegetable-based products that are available in New Zealand supermarkets.

Methods: Nutrition Information Panel data were collected from non-frozen, processed fruit and vegetable products in New Zealand supermarkets (including soups, sauces, jams and spreads, pickles, chutneys and dips, and canned/bottled fruit and vegetables) where fruit and/or vegetables were the majority ingredient(s).

Results: With the exception of canned/bottled vegetables, more than 60% of products contained added sugar. Per serve, the median sugar content was highest in canned/bottled fruit (17.8 g). More than 75% of soups, vegetable-based sauces, pickles/chutneys and canned/bottled vegetables contained added sodium, with soups (722 mg) recording the highest median values per serve.

Conclusions: Consumers need to be aware that although they are encouraged to eat a diet high in fruit and vegetables, there may be large quantities of added sugar and sodium in manufactured fruit and vegetable products that can have significant negative impacts on their health. Government health promotion campaigns encouraging the consumption of fruit and vegetables should be careful to target fresh, frozen and home-prepared foods, and work on educating the public about the lower nutritional quality associated with most processed fruit and vegetable products.

Key words: added sodium, added sugar, processed fruit and vegetables.

Introduction

Public health campaigns regularly promote fruit and vegetable consumption due to the variety of vitamins, minerals and dietary fibre that they provide, with the aim of reducing population incidence of chronic disease.¹ Indeed, fruit and/or vegetable intake has been positively associated with a decreased risk of type 2 diabetes,² slower weight gain/reduced adiposity,³ and reduced risk of coronary heart disease.⁴

Government guidelines in New Zealand and Australia recommend and actively promote consuming at least two servings of fruit and three⁵ to five⁶ servings of vegetables, respectively, per day. General public perceptions of fruit

and vegetable products is that they are healthy,⁷ although actual intakes are questionable as recommended intakes and portion sizes are often not correctly identified.⁸ Furthermore, evidence suggests that supermarkets are now dominated by ultra-processed foods including many packaged and processed fruit and vegetable products.⁹ Such foods are nearly always less healthy than those that are minimally or not processed,⁹ often containing increased levels of sugar and salt in an attempt to increase the palatability of food.¹⁰ However, while consumers do perceive processed foods to be less healthy,⁷ anecdotal evidence suggests that there are mixed messages between the 'unhealthiness' of a processed fruit or vegetable product and the requirement to add more fruit and vegetables into the diet. Importantly, there appears to be limited information specifically describing the nutritional profile of processed fruit and vegetable products in Australia and New Zealand. Only a small number of studies have reported on the sodium content of processed foods^{11–13} and there appears to be a complete lack of published literature describing the sugar content of processed foods in Australia and New Zealand. Given the significance of sugar and salt on the development and progression of chronic disease,¹⁴ and the knowledge that

L. Chepulis, PhD, Senior Research Fellow

N. Everson, BN, Student Nurse

A. Heapy, PhD, Group Manager

G. Mearns, PhD, Associate Head of Postgraduate Studies

Correspondence: L. Chepulis, Waikato Medical Research Centre, University of Waikato, Private Bag 3105, Hamilton, New Zealand. Tel: +64 7 837 9553.

Email: lynne@waikato.ac.nz

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up to 90% of the energy from added sugars comes from processed foods,¹⁵ the current study aims to evaluate the sugar content and sodium levels in processed fruit and vegetable products available in New Zealand supermarkets.

Methods

Nutritional composition data were collected from all processed fruit and vegetable-based products from three large supermarket chains (Countdown, Pak 'n' Save and New World) in Rotorua, New Zealand stores during November to December 2017. These supermarkets represent approximately 92% grocery market share.¹⁶ Data were obtained from both the online grocery shopping websites and by visiting the stores in person and taking photographs of the packaging, ingredients list and nutritional information panel (NIP) of each product. Products with multiple package sizes were included only once into the product dataset (unless different product sizes had different nutritional information). For reliability, 10% of products from which the NIP data were sourced online were manually checked against actual product information in store.

Products were included in the dataset if they were a non-frozen, processed fruit and vegetable-based product with a full NIP available. Products were deemed to be fruit or vegetable-based if fruits or vegetables were listed either first or second on the ingredients list, and if the total fruit and vegetable content of the product was at least 25% (where described in the ingredients list). Products were excluded if they were not packaged as a ready-to-eat product, including all concentrates (e.g. tomato paste) and marinades.

For each product, the following data were recorded: brand name, product name, packet size, manufacturer-declared serving size, ingredients list, content of energy (kJ), protein, fat (total), carbohydrate, sugar and sodium (per 100 g and per manufacturer-declared serve). The percentage of products that had sugar (defined as sugar, cane sugar, honey, glucose-fructose syrup, glucose, sucrose, fructose, and/or high fructose corn syrup) or sodium (including 'monosodium glutamate' and 'salt') added to them were also recorded. Labels where the amount of a nutrient was recorded as <1 g, <0.1 g or <5 mg were entered as 0.5 g, 0.05 g and 2.5 mg, respectively, into the spreadsheet.

All product categories, as well as certain sub-categories (e.g. baked beans, other beans, pasta sauce and canned tomatoes) were assessed and compared for differences in sugar and sodium content as well as the proportion of products with added sugar/sodium. The number of products promoting a 'low sugar' option (including use of the terms 'no added sugar', '50% less sugar', 'low sugar') or reduced sodium ('reduced salt', 'no added salt', 'low sodium', 'reduced sodium') were also analysed.

Canned/bottled fruit data were further analysed to determine whether there was a difference in the proportion of products that were canned/bottled in syrup versus in juice with regard to: (i) the median sugar content, (ii) the

proportion of products with added sugar and (iii) the proportion of products that were promoted as being 'low sugar'.

The nutritional quality of a small number of processed products that contained only one fruit or vegetable ingredient were then compared to fresh alternatives. The nutritional information for fresh products was taken from the United States (US) Food and Drug Administration (FDA) 'Nutrition information for raw fruits, vegetables and fish'.¹⁷ Processed fruit and vegetable nutrition information was sourced from the present study data, with values reported being those with the highest sugar/sodium content across all comparable products (e.g. all whole canned tomato products).

As NIP information is largely dependent on manufacturer-declared serve size, the present study also assessed the difference in serving size across a number of categories and sub-categories for the impact that this may have on interpretation of nutritional information. Manufacturer-declared serve size information from various product categories/sub-categories was compared to the 2018 US FDA recommended serve size information.¹⁸ These values are reported as reference amount of customarily consumed (RACC) values. US FDA guidelines were used rather than New Zealand guideline values, as current serving size guidelines in New Zealand are difficult to quantify for processed fruit and vegetable products.⁵

The data were analysed using R version 3.2.0 (R Core Team, Austria) for OSX. As most variables were not normally distributed, category level summary statistics are reported as median and interquartile range (IQR). Kruskal Wallis testing with Dunn *post hoc* analysis was used to determine variance for the sugar and/or sodium content of all categories, canned fruit sub-categories, and chi-square comparisons for the proportion of canned fruit with added sugar.

Results

A total of 899 products were analysed across seven categories, including soups ($n = 106$), vegetable-based sauces ('vegetable sauces'; $n = 176$), fruit-based sauces ('fruit sauces'; $n = 16$), jams and spreads ('jams'; $n = 72$), chutneys, pickles and dips ('chutneys'; $n = 121$), canned/bottled vegetables ('canned vegetables'; $n = 286$) and canned/bottled fruit ('canned fruit'; $n = 122$).

The proportion of products with added sugars was high across all categories: 88.9% (jams), 87.5% (fruit sauces), 80.7% (vegetable sauces); 78.3% (soups), 76.9% (chutneys), 60.7% (canned fruits) and 42.9% (canned vegetables). Per serve, canned fruits had the highest median sugar content with 17.8 g (IQR = 14.2, 24.6) with all other product categories averaging under 6.5 g per serve (Figure 1). Jams had the highest sugar content per 100 g (median: 61.8 g; IQR = 52.0, 64.4), this being significantly higher than all categories except fruit-based sauces (31.6 g; IQR = 14.9, 40.0; $H = 327.6$; $P < 0.0001$). The median

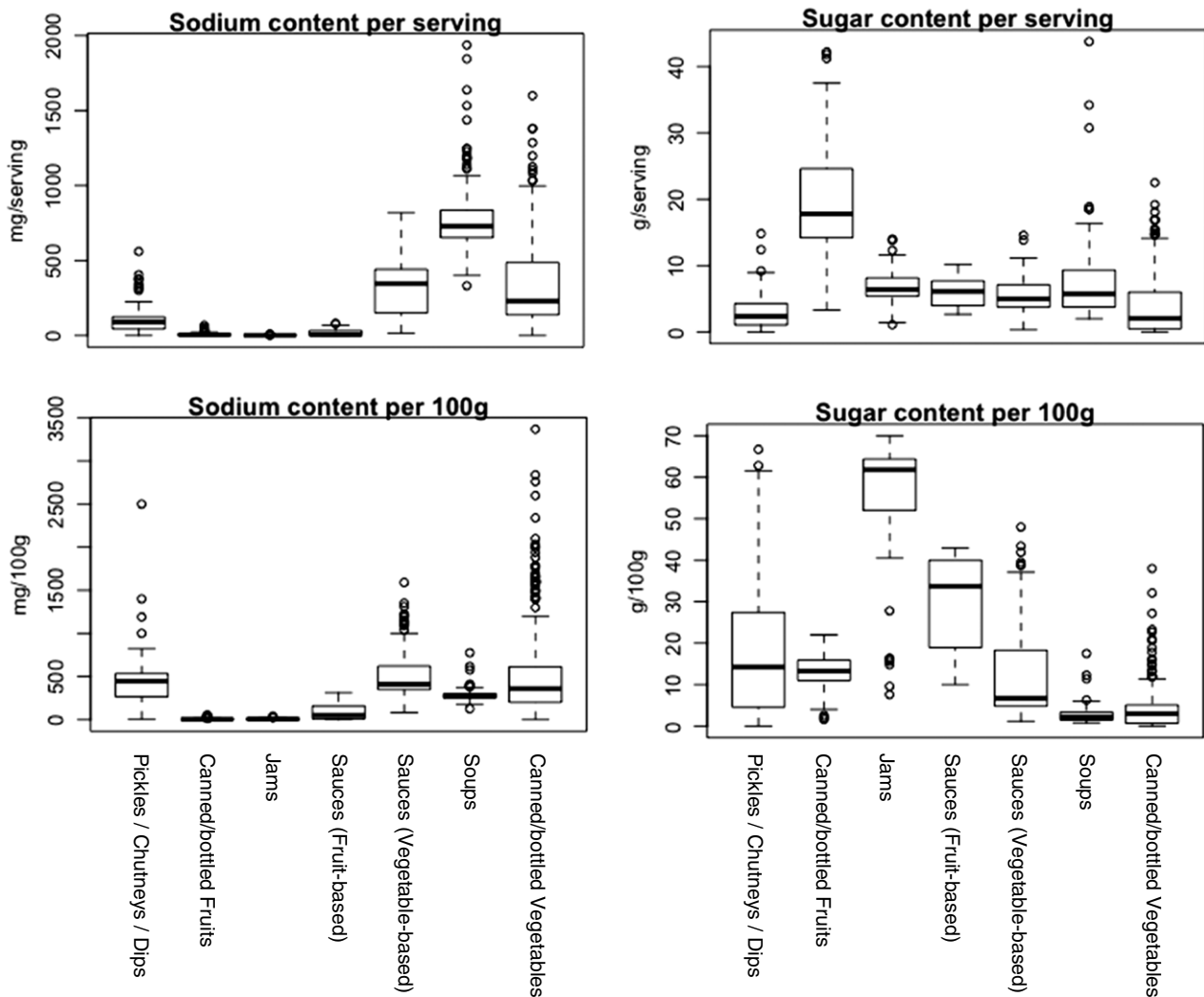


Figure 1 Sugar and sodium content per 100 g and per manufacturer-declared serve of fruit- and vegetable-based products (box plots report median, IQR, maximum and minimum).

sugar content (per 100 g) of other product categories ranged from 2.2 g (soups) to 14.2 g (chutneys) (Figure 1).

When compared across product groups, fruit canned in syrup contained significantly more sugar per single serve compared with fruit canned in juice (median: 23.4 g vs 14.6 g; $H = 27.3$; $P < 0.001$), and a lower proportion of fruits in syrup were promoted as being lower in sugar (14.8% vs 29.8% of fruit in juice; $\chi^2(1, n = 108) = 3.5$, $P = 0.05$). However, there was no statistically significant difference between the median sugar content per serve of 'all' fruits canned in syrup compared to those promoted as being 'low sugar' (23.4 g vs 25.8 g; $H = 0.27$; $P = 0.60$). This result was offset by differences in the manufacturer recommended serve size, with 'low sugar' syrup products being marketed with a higher manufacturer-declared serve size than fruit canned in syrup (median: 205 g vs 135 g; Table 1). Importantly, 'low sugar' fruits in syrup still contained over one-third more sugar per serve than fruit in juice (25.8 g vs 14.6 g; $H = 3.7$; $P = 0.05$) and twice as much sugar as 'low sugar' fruits in juice (25.8 g

vs 12.9 g; $H = 3.4$; $P = 0.06$); though again median serve size differed across these categories (Table 1).

Further analysis of the canned fruit data in our study indicated that the products with the lowest sugar content per serve (<10 g, $n = 14$ (11.5%)) contained mostly fruit and water, half contained 'sweeteners', and only two products contained sugar. In contrast, of the products with the highest sugar content per serve (>25 g, $n = 26$ (21.3%)), 100% contained added sugar, and all were fruits canned in syrup. One-quarter of these 26 'highest sugar' products ($n = 6$) were fruits canned in 'light syrup'.

The proportion of vegetable-based products with additional salt was high, including nearly all soups (94.4%) and vegetable sauces (96.0%) as well as more than three quarters of all canned vegetables (75.4%) and chutneys (79.3%). One-third of fruit-based sauces contained added salt, but less than 4% of other fruit-based products (Table 2).

Due to the proportionately larger serve size (median: 250 g; IQR = 250, 300), soups had the highest median

Table 1 Sugar content of canned fruit products

Product		Number of products	Manufacturer-declared serve size (g; median [IQR])	Sugar per serve (g; median [IQR])	Proportion of products with added sugar (%) ¹	Proportion of products promoting 'low sugar' (%) ^{1,2}
All canned fruit ³		122	125 [120, 205]	17.8 [14.2, 24.6]	54.9	20.5
Canned fruit in syrup ⁴	All	61	135 [120, 205]	23.4 [18.7, 27.0]	95.1 ^a	14.8 ^a
	'Full sugar' syrup	52	132.5 [117, 205]	23.6 [18.8, 30.3]	100	—
	'Low sugar' versions ¹	9	205 [205, 205]	25.8 [14.2, 26.4]	66.7 ^b	—
Canned fruit in juice ⁴	All	47	125 [117, 147]	14.6 [11.4, 16.4]	6.4 ^c	29.8 ^b
	'Low sugar' versions ¹	16	120 [112, 200]	12.9 [9.3, 15.2]	6.3 ^c	—

¹ Letters within the same column are significantly different from each other as per Dunns *post hoc* test ($P < 0.001$).

² Include the terms 'no added sugar', '50% less sugar' and 'low sugar'.

³ Includes all canned fruit products, including those in syrup, in juice and those for which the liquid was not defined (or was not present, e.g. pureed fruit).

⁴ Based on the wording on the product label.

level of sodium per serve (721.8 mg; IQR = 654.4, 834.2). However, vegetable-based sauces also contained high sodium content (median: 318.6 mg; IQR = 156.2, 440.9) despite an average serve size of only 83.5 g (IQR = 20, 125). Per 100 g of product, the highest median sodium was observed in chutneys (444.5 mg; IQR = 268, 533), this being significantly higher than all categories except vegetable-based sauces (403.0; IQR = 333, 702) and canned vegetables (357.5; IQR = 191.0, 600.0) ($H = 252.3$; $P < 0.0001$). The lowest sodium content was observed in fruit-based sauces, jams and canned fruits, with comparable values across all three categories. The sodium content of all primary categories is given in Figure 1 and Table 2.

Sub-category analysis showed that baked beans contained the highest median level of sodium per serve (805.8 mg), this being nearly twice that of other bean products (448.1 mg; $H = 15.2$; $P = 0.0001$). Pasta sauces also contributed, on average, more than 400 mg of sodium per serve. The sodium content within most sub-categories varied greatly (see below) and was not entirely described by differences in manufacturer-declared serve size. Sodium content of baked beans, for example, varied 5-fold from 260 to 1380 mg per serve, (minimum, maximum) despite only a 2.5-fold difference in serving size (125–300 g).

Of the eight different fresh/processed products compared, all had a lower nutritional profile after processing compared to their fresh alternatives (Table 3). The sugar content of canned fruit was 26%–101% higher compared with fresh fruit (per 100 g of product), while the sodium content of beans, corn and whole tomatoes increased dramatically from an average of 2.0–5.6 mg per 100 g in fresh products to 115–250 mg in the canned alternatives. In contrast, small reductions in sugar content were seen in canned vegetables compared to their fresh counterparts (Table 3).

Manufacturer-declared serving size was highly variable across all categories and sub-categories that were assessed (Table 2). Based on US FDA RACC guidelines, more than 80% of baked beans and soups exceeded the suggested serve size, as well as approximately one-third of all pasta sauces, canned vegetables, canned fruit and other beans.

Discussion

Processed foods are known to be significant contributors of sugar and sodium,¹⁰ and our data suggests that this is also true for processed fruit and vegetable products, despite the fact that they are often perceived to be healthy food products.⁷

It is concerning that up to 90% of all products surveyed in the present study contained added sugars. While high sugar content is generally expected for products such as jams and spreads, high levels were also seen in other product categories. One-third of all chutneys and pickles also contained more than 20% sugar, with 10% of products in this category containing more than 30% sugar. It has been reported that chutneys and pickles sales have declined in the UK in recent years, particularly with younger generations.¹⁹ Thus, while specific sales data for New Zealand were not available, it is possible that the relatively high sugar content of many of these products is manufacturer-driven in order to deliver a product that better meets consumer preference for sweetened products. The data in the current study also reported that the median sugar content from canned fruits was high with more than 75% of all canned fruit products providing 3–5 teaspoons (15–25 g) of sugar per serve. These products are an important contributor to daily sugar intake given that current World Health Organisation recommendations suggested limiting free sugars to approximately 5% of the total energy intake

Table 2 Sodium content and manufacturer-declared serve size information of processed vegetable-based products

Product	Manufacturer-declared serve size (g)				Sodium content			Serving size	
	Number of products	Median [IQR]	Minimum	Maximum	Sodium per serve (mg; median [IQR])	Proportion of products with added sodium (%)	Number of products promoting 'low sodium/salt' (%) ^(a)	RACC serve size (g) ^(b,c)	Proportion of products exceeding (%) RACC
Soups	106	250 [250, 300]	200	450	721.8 [654.4, 834.2]	94.4	3 (2.8%)	245	88.7
Fruit-based sauces	16	25 [14, 30]	10	30	5.0 [2.9, 45.2]	31.3	0 (0%)	—	—
Jams	72	10 [10, 15]	10	50	0.5 [0.4, 1.5]	1.3	0 (0%)	20	5.6
Vegetable- based sauces	176	83.5 [20, 125]	10	300	318.6 [156.2, 440.9]	96.0	4 (2.3%)	—	—
Tomato sauces ^(d)	32	15 [15, 15]	10	50	142.1 [94.1, 164.3]	86.7	3 (10%)	30	9.4
Pasta sauce ^(e)	79	125 [100, 127]	80	188	437.5 [372.4, 477.9]	97.4	1 (1.3%)	125	29.1
All canned vegetables	286	120.5 [50, 130]	45	300	221 [135.7, 461.8]	75.4	9 (11.3%)	130	35.3
Baked beans	25	210 [205, 210]	125	300	805.8 [504.7, 981.1]	96.0	2 (8%)	130	84.6
Canned tomatoes	36	100 [80, 130]	80	200	120.0 [15.0, 172.0]	44.5	1 (2.8%)	130	25.7
Canned beans (non-baked)	45	130 [108, 200]	60	225	448.1 [201.1, 585.7]	82.2	1 (2.2%)	130	37.8
All canned fruit	122	125 [120, 205]	85	212	4.1 [3.1, 10.2]	3.8	0 (0%)	140	32.2
Pickles/chutneys/ dips	121	20 [15, 25]	10	47.5	89.8 [42.6, 123.7]	79.3	0 (0%)	—	—

^(a) Includes the terms 'reduced salt', 'reduced sodium' and 'low sodium'.^(b) Data taken from 2018 Food and Drug Administration (FDA) recommendations.¹⁹^(c) Only products with equivalent reference amount of customarily consumed (RACC) serve size information is reported.^(d) Includes all sauces that include the terms 'tomato sauce', 'ketchup' or 'pizza sauce'.^(e) Includes all sauces that include the terms 'pasta sauce' or 'bolognese sauce'.

per day (equal to ~30 g of sugar in a person aged over 11 years).²⁰ However, it is important to note that New Zealand NIP labels currently do not distinguish between added sugars and those occurring naturally in food ingredients such as fruits and dairy.

Our data showed that there was a difference in the sugar content of canned fruits with many of the highest sugar products being canned in 'light syrup'. In addition, there was no significant difference in the sugar content of fruits canned in 'light syrup' versus those in full sugar syrup, while products canned in 'light syrup' contained up to twice as much sugar as fruits canned in juice. This is a strong, yet misleading message that fruits canned in 'light syrup' may be healthier, or nutritionally better than their full syrup counterparts. Instead, products canned in juice should be more strongly promoted as being healthier options.

As Table 3 shows, canned fruits were also generally a poorer nutritional choice than their fresh alternatives. New Zealand nutrition guidelines recommend at least two servings of fruit per day and processed foods look likely to remain an important contributor of the typical western diet. This suggests that policy and nutrition guidelines should continue to advocate for increased fruit and vegetable intake, including from canned goods, but that consumers should be made aware of the importance of selecting fruits canned in juice or water rather than syrup. More research is

needed on fresh versus processed fruit and vegetable consumption and the factors that influence purchasing and consumption patterns.

The 5+ a day model promotes that at least three servings of the 5+ per day should be vegetables.⁵ However, there appears to be little current data describing the vegetable intake patterns of New Zealanders, including what proportion of vegetables are from processed sources. What is most concerning from our data is the sodium content of many processed vegetable products, particularly as studies report a causative link between sodium intake and reduced health.²¹ Current New Zealand Guidelines suggest that the recommended daily intake of sodium ranges from 930 to 2300 mg⁵ and in our study a number of vegetable-based products reached these lower limits in only one serve.

It is also important to note that data about which foods contribute to sodium intake in New Zealand is considerably out of date. The 2015 Eating and Activity Guidelines for New Zealand⁵ refer to the 1997 National Nutrition Survey to describe key sources of dietary sodium. However, both this and another study which used dietary recall data¹¹ suggest that New Zealanders regularly consume more than the recommended amounts of sodium. A recent review of 182 New Zealand processed foods (including breads, cereals, butters, canned meats, cheese, crackers and canned vegetables) indicated that there has been little change in the sodium content of these foods overall between 2003 and

Table 3 Sodium and sugar content of example processed^(a) versus fresh^(b) fruit and vegetables

Product		Product/ serve size (g)	Energy (kJ)		Sugar content (g)		Sodium content (mg)	
			Per serve	Per 100 g	Per serve	Per 100 g	Per serve	Per 100 g
Fruits								
Apples	Fresh, one large	242	546	225.6	25.0	10.3	0	0
	Pie filling, apple	125	425	340.0	16.3	13.0	3.75	3.0
Peaches	One medium	147	252	171.4	13.0	8.8	0	0
	canned (slices in syrup)	205	410	200.0	21.8	10.6	4.1	2.0
Pears	One medium	166	420	253.0	16.0	9.6	0	0
	canned (quarters in syrup)	205	492	240.0	27.1	13.2	4.1	2.0
Plums	Two medium	151	294	195.3	16.0	10.6	0	0
	canned (in syrup)	212	355	167.5	42.2	19.9	4.2	2.0
Pineapple	Fresh, two slices	112	210	187.5	10	8.9	0	0
	Canned (slices in syrup)	125	288	230.4	23.4	18.7	2.9	2.3
Vegetables								
Beans	Fresh, green, whole	100	105	105.0	2.4	2.4	3.0	3.0
	Canned (4-bean mix)	125	863	690	1.0	0.8	143.8	115.0
Corn	Fresh, kernels from one ear	90	328	464.0	5	5.6	5.0	5.6
	Canned (kernels)	80	288	360.0	2.6	3.25	100.0	125.0
	Canned (creamed corn)	100	405	405.0	2.9	2.9	165.0	165.0
Tomatoes	Fresh, one medium	148	105	70.9	20	13.5	3.0	2.0
	Canned (whole, peeled in juice)	80	64	80.0	2.4	3.0	200.0	250.0

^(a) Data extracted from study data. Values reported are those for products with the greatest sugar/sodium content across all comparable products.

^(b) Information taken from the United States Food and Drug Administration 'Nutrition information for raw fruits, vegetables and fish'.¹⁷

2013, though their data report that the median sodium content of canned vegetables ($n = 39$) decreased from 241 to 137 mg/100 g during this time.²² Sub-category analysis showed that a number of baked bean products ($n = 9$) decreased their sodium content by approximately 10% during this 10-year period achieving a median sodium value in 2013 of 415 mg/100 g.²² This is comparable to the results seen in our study with 2017 data. This is an important finding suggesting that manufacturers may be reformulating to meet consumer needs; however, the results of the present study are indicative at best, the authors themselves noting that any conclusions are confounded by changes in market availability and a lack of sales-weighted data. That said, very few products in our study were promoted as being low in sodium and this is something that could easily be implemented, thereby allowing consumers to easily recognise low-sodium options.

In addition, it is important to identify that all serving size information used in our study refers to manufacturer-reported information on the NIP labels. This itself is variable, with at least a 2–3 times difference in size across comparable products in many sub-categories. Adherence to such portion sizes is also questionable, with evidence suggesting that consumers regularly consume higher serve sizes than those recorded on product packaging,²³ instead often using factors such as container size²⁴ to determine the portion consumed. It would be useful in future studies to evaluate public perceptions of portion size, and knowledge of dietary guidelines to determine what impact these have on purchasing choice or consumption patterns.

Government campaigns in New Zealand continue to promote the intake of fruit and vegetables, but little emphasis is placed on the quality or source of these foods. New Zealand Ministry of Health guidelines do suggest that New Zealanders should actively choose canned fruit and vegetables that offer reduced sugar and sodium levels,⁵ though it is questionable whether this message is promoted alongside that to increase fruit and vegetable intake. Furthermore, while it has been shown that many consumers are often aware of the sodium content of processed foods, most do not use or check NIP labels to determine sugar²⁵ or salt²⁶ content. Thus, it is suggested that front-of packaging labels using 'reduced' claims may be a more effective means at targeting the general populace to influence product choice.²⁷ Strategies should also be implemented to encourage the specific intake of fresh fruit and vegetables (and/or home-made products) rather than processed alternatives. Additionally, more research is needed on factors influencing consumer purchasing and consumption patterns, to identify and address why consumers may prioritise processed fruit and vegetables over fresh products. Lastly, it would be valuable in future studies to assess fruit and vegetable products that were not included in the present study (e.g. crisps, marinades and product concentrates), and to include products from multiple regions of New Zealand so as to avoid any location bias.

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Conflict of interest

The authors have no conflict of interest to declare.

Authorship

LC designed the study, supported data collection/analysis and prepared the manuscript. NE collected all data and prepared data for analysis. AH supported study design and manuscript writing. GM contributed to statistical analysis and manuscript writing. All authors have contributed to the critical revision of the article, have reviewed the final version and approved the manuscript.

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