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RESEARCH ARTICLE

Acceptance, availability, and accessibility of reformulated sugar-sweetened beverages in Pietermaritzburg, KwaZulu-Natal, South Africa

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Background: The rising obesity rates in South Africa (SA) can be attributed to the high availability, accessibility, and excessive consumption of sugar-sweetened beverages (SSBs). In response, SA introduced the Health Promotion Levy (HPL) in 2018 to increase the price of SSBs and discourage consumer purchases. Some SSBs were reformulated to reduce sugar content and reduce tax liability. The sensory qualities of reformulated SSBs (RSSBs) may be different, leading to poor acceptance.
Objective: To assess the acceptability of RSSBs among consumers employed at schools, and the availability and accessibility of RSSBs at major retail grocery stores (MRGSs) in Pietermaritzburg (PMB).
Methods: A cross-sectional descriptive study was conducted at 13 schools in PMB ($n = 192$). A sensory evaluation was used to assess the acceptability of six RSSB samples (zero-sugar and light soft drinks, squash, sports/energy drink, iced tea, and flavoured water). A survey was conducted at MRGSs ($n = 10$) to assess the availability and accessibility of the RSSBs.
Results: The light ($p < 0.05$) and zero-sugar soft drinks ($p < 0.05$), and sports/energy drink ($p < 0.05$) were acceptable to the consumers; however, the flavoured water ($p < 0.05$) and iced tea ($p < 0.05$) were less acceptable. Soft drinks, squash; and sports/energy drinks were most available at the MRGSs. A soft drink brand was the most accessible, taking the most shelf space (mean = 1 773.90 cm ± 3 199.93 cm) and situated at all shelf levels (top, middle, and bottom).
Conclusion: Consumers were accepting of the reformulated soft drink and sports/energy drink. Furthermore, soft drinks, squashes, and sports/energy drinks were the most available and accessible RSSBs at MRGSs.

Keywords: availability, accessibility, consumers, obesity, sugar-sweetened beverages, sensory evaluation

Introduction

Obesity rates are rising worldwide resulting in health complications, increased healthcare costs, and reduced productivity.[1] According to the World Health Organization (WHO), the global prevalence of obesity tripled from 1975 to 2016.[2] The obesity rates in South Africa (SA) have risen over the past 30 years, making it the 'most obese' country in sub-Saharan Africa.[3] School-based obesity preventative strategies are important for preventing obesity in adulthood because children develop lifelong health-related habits at school and are easily influenced by their educators.[4] Therefore, school staff should be healthy role models to children in terms of food and beverage choices. Research has generally focused on how the school environment impacts obesity in learners.[4] However, school-based obesity prevention strategies should involve both school staff and learners.[4] Improved awareness of the relationship between sugar-sweetened beverage (SSB) consumption and the health of school staff could help support obesity preventative strategies, such as sugar taxes in the school setting.[5] A study by De Villiers et al., conducted at eight South African schools, suggested the need for healthy lifestyle promotion among educators.[6]

Worldwide, the increasing consumption rates of SSBs are contributing to obesity due to their high sugar and energy content.[7] Sugar-sweetened beverages include soft drinks, fruit drinks, sports/energy drinks, vitamin water drinks, sweetened iced tea, and lemonade, as categorised by the National Treasury in SA.[3] South Africa is regarded as a major consumer of sugar due to the wide accessibility and availability of SSBs.[3] SA purchase the majority of SSBs from major retail grocery stores (MRGSs).[8] Availability means that the reformulated SSBs (RSSBs) are present and visible to the consumer when shopping, while accessibility means that the consumer can easily see and touch the SSB.[9] Visual merchandising strategies are used by MRGSs to increase the sales of popular brands and enhance new products introduced to the market.[10] These strategies include tactful shelf location and determining length of shelf space for brands.[10] The greater the length of shelf space taken by a brand, the more popular and faster selling it is.[10] Vertical shelf levels are categorised as the top, middle, and bottom. When SSBs are allocated on all these shelf levels, the sales of SSBs could be increased as this increases accessibility.[10] Brands displayed at eye-level (middle) are more visible, which may promote sales at MRGSs.[10] Popular brands are usually assigned to the middle shelves. Brands on lower shelves are expected to be cheap, while brands on high shelves are expected to be expensive.[10] Stores seek suppliers of SSBs to allocate their shelf space to and will look for popular brands to maximise their profits.[10] In addition, popular brands take up more shelf space in comparison with less popular brands. Suppliers of SSBs may offer MRGSs financial incentives to obtain larger space allocations and they compete with other SSB suppliers for shelf space.[10]

To reduce the consumption of SSBs in SA, a sugar tax, subsequently referred to as the Health Promotion Levy (HPL), was implemented in April 2018, resulting in an 11% increase in the price of SSBs.[11] This strategy is meant to discourage consumer purchases, thereby reducing sugar intake.[12] To further reduce sugar intake, SSB manufacturers were incentivised to lower the sugar content in their SSBs, referred to as 'reformulation'.[12] In SA, SSB manufacturers reduced the sugar content in their products, and/or used non-nutritive sweeteners (NNS)

instead of sugar, to avoid or decrease their tax liability.[11] Thereafter, RSSBs emerged on the South African market.[9] 'Zero sugar' RSSBs differ from SSBs because they contain no sugar, while 'low-sugar' or 'low-energy' options contain less sugar.[9] According to Wrottesley et al., SSB manufacturers in SA reduced the sugar content of SSBs by 21% on average, between 2018 and 2020.[13] According to Bercholz et al., by 2019, the sugar content of SSB purchases fell by 4.9 g/capita/day versus pre-announcement in SA.[14] Awareness of the HPL was responsible for a 71% reduction in the total change in SSB consumption, whilst reformulation of SSBs was responsible for a 34% reduction.[14]

Reformulation of SSBs remains a challenging task for manufacturers[9] as it may alter sensory attributes, changing the flavour and texture balance.[15] The direct reduction of sugar in SSBs is the most effective method for reducing sugar intake; however, this may have a negative impact on acceptance due to the reduced sweetness.[16] Some RSSBs contain NNSs, which leave a bitter aftertaste in the mouth, while some RSSBs taste sweeter than the original.[9] The use of NNSs may be associated with health concerns, thus affecting their acceptability.[14] Although RSSBs may be an appropriate initial replacement for SSBs during the transition to unsweetened beverages, water should be emphasised as the healthiest beverage option.[7] While the acceptability of RSSBs has not been widely studied, evidence suggests that consumers may support SSB reformulation if they are convinced that it aims to improve their health.[14,16] However, RSSBs will only be successful, in terms of sales, when consumers perceive the new product as high quality and tasty.[9] To the best of the researchers' knowledge, there are no published South African studies on the consumer acceptability of reformulated versions of iced tea and flavoured water, which contributes to the novelty of the current study. In addition, few studies have been conducted on the health status of school employees, who are also consumers.[5] Therefore, this study assessed the acceptability of RSSBs among school employees. These consumers shop at MRGSs in Pietermaritzburg (PMB), where this study investigated the availability and accessibility of RSSBs.

Study methods and materials

Study design

The study was a cross-sectional, observational study that collected quantitative data during August and September 2023. Figure 1 depicts the processes followed during the study.

Study population and sample selection

Schools

A list of 96 schools in PMB from the South African Department of Basic Education (DOE) was used to locate all schools for the study.

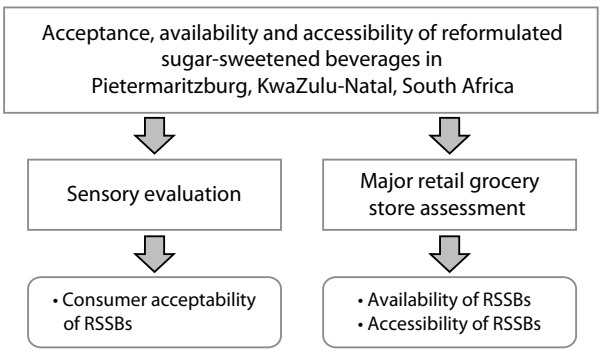

Figure 1: Processes followed during the study.

Consumers

The consumers were adults living in PMB and employed at PMB schools, which were sampled for inclusion in the study and gave permission to participate. Consumers were sampled through convenience sampling. All staff were invited to participate, but only consumers who met the inclusion criteria and agreed to participate were given a consent form to complete and were allowed to participate in the study. The recommended sample size for a sensory evaluation is at least 100 participants.[17] The researchers exceeded this number during data collection with a sample size of 192, making the sample size sufficient to draw conclusions. Data from all 192 participants were included and analysed.

MRGSs

A list of MRGSs in the South African grocery sector was obtained from the Grocery Retail Market Inquiry (2019) and was used to locate the PMB MRGSs for the study. The lottery method, which is a type of simple random sampling,[18] was applied to select the MRGS if more than one branch gave permission to participate.

Sensory evaluation (affective testing)

A sensory evaluation questionnaire was developed with a five-point facial hedonic scale. The consumers rated the liking of specific sensory modalities (appearance, taste, smell, and sound) of the RSSBs and the overall acceptability. A panel of experts validated the sensory evaluation questionnaire by reviewing it for concision and relevance, assessing the content validity and suggesting improvements.

The classroom, board room, or hall allocated by the schools for the sensory evaluation was a quiet area with no strong odours and standardised lighting and temperature. Brief but concise instructions on how to perform the sensory evaluation were given to each consumer beforehand. The consumers recorded their responses whilst seated apart from each other to avert discussions. A research assistant prepared and served the RSSB samples. The squash sample had to be diluted with water according to packaging instructions. This was done prior to arrival at the schools in a sanitised home-kitchen. The Food and Agriculture Organization (FAO) recommends the following procedures, when planning to consume squashes later in the day: Prepare in small batches, store in airtight containers, keep refrigerated and consume within 24 hours.[19] These recommendations were followed in the current study. The RSSBs were served at refrigeration temperature (3–5°C).[19] A 50 ml sample of each RSSB sample was decanted into disposable cups two minutes before the sensory evaluation commenced. The samples were labelled with random numbers and still bottled water was given to each consumer to cleanse their palate between tasting the samples.

Soft drinks are the most popular SSB in SA.[20] For this reason, the two reformulated versions of a popular soft drink in SA were used for the sensory evaluation. These were the 'zero sugar' and 'light' versions. Using the MRGS checklist, brands of RSSBs for the remaining categories were selected using random sampling and one of each was included in the sensory evaluation. After the RSSBs were selected, the flavour for each RSSB was randomly sampled for inclusion. Six RSSBs with their corresponding flavours were selected: soft drink – light (manufactured using no sugar but with a lighter taste compared with the original product), soft drink – zero sugar (looks and tastes like the original product but has no sugar), squash – low

energy and lemon and lime flavoured, sports/energy drink – zero sugar and blueberry flavoured, flavoured water – low energy and peach flavoured, and iced-tea – sugar free and lemon flavoured. A pilot study with 20 consumers took place before the main study was conducted. Pilot study participants understood all instructions and completed the sensory evaluation in 15–20 minutes. The researchers adapted the sensory evaluation questionnaire to read 'not applicable (N/A)' in the rows indicating 'sound' for RSSBs that did not have an effervescence.

MRGS checklist

The researchers compiled a checklist of RSSBs to be used at the MRGSs. Only the highest selling SSBs that were available for sale in SA in 2021 were included in the checklist. These were obtained from the Euromonitor Passport International.[20] The RSSBs were then categorised according to the classification of SSBs from the National Treasury. These RSSBs were the most available and accessible in SA.[20] This implies that these RSSBs would likely be available and accessible in PMB MRGSs. A separate checklist was used at each MRGS. To assess availability, the researchers documented whether each RSSB was present in the MRGS or not. Following this, accessibility of each RSSB was determined by noting whether it was located at the top, middle, or bottom of the shelf. More than one option could be selected. Accessibility was also determined by measuring the length of the shelf space taken by each RSSB, using a measuring tape. Because two branches of one MRGS agreed to participate in the study, one was selected for the main study, while the other was selected for the pilot study. During the pilot study, the researchers realised the need to carefully check each aisle for RSSBs as these were placed in various sections of the MRGS. In addition, some brands were found to have been discontinued and were removed from the checklist before the main study.

Statistical analysis

In addition to response frequencies, a one-sample *t*-test was applied to determine whether consumers significantly 'liked' or 'disliked' the sensory qualities of the RSSB samples. A one-sample *t*-test was used to test whether the mean score was significantly different from a scalar value. Data were coded such that 1 = 'dislike very much' and 5 = 'like very much'. The average score was tested against a neutral score of '3'. Data were captured from the MRGS checklist onto a Microsoft Excel spreadsheet (Microsoft Corp, Redmond, WA, USA). Thereafter, data were analysed using the Statistical Package for the Social Sciences (SPSS) Version 26 (IBM Corp, Armonk, NY, USA). A value of $p < 0.05$ was regarded as statistically significant.

Ethical considerations

Ethical approval was obtained from the University of KwaZulu-Natal (UKZN) Human Social Sciences Research Ethics Committee (HSSREC) (Reference Number: 00005595/2023). The DOE uMgungundlovu District Municipality gave approval for the study to be conducted at schools in PMB. Store managers, who served as gatekeepers of each MRGS, also gave permission for the study to be conducted at the stores.

Results

Thirteen out of 96 schools participated in the sensory evaluation, resulting in a response rate of 13.5%. A total of 192 consumers and 10 MRGSs participated in the study.

Consumer acceptance of the appearance of RSSBs

Table 1 indicates the consumer rating of the appearance of the RSSB samples.

The consumers liked the appearance of the light soft drink (mean = 3.84 ± 0.977; $p < 0.05$); zero-sugar soft drink (mean = 3.63 ± 1.032; $p < 0.05$); squash (mean = 3.41 ± 1.228; $p < 0.05$), and the sports/energy drink (mean = 4.07 ± 1.119; $p < 0.05$). However, the appearance of the iced tea was disliked by the consumers (mean = 2.76 ± 1.339; $p = 0.017$) (Table 1).

Consumer acceptance of the sound of RSSBs

Table 2 indicates the consumer rating of the sound of the RSSB samples.

Consumers did not assess the sound of samples 3, 4, and 6 as these products do not have effervescence. Consumers liked the sound of the light soft drink (mean = 3.64 ± 0.968; $p < 0.05$)

Table 1: Consumer rating of the appearance of RSSB samples

Sample number	1	2	3	4	5	6
Type of RSSB	Soft drink	Soft drink	Squash	Sports/energy drink	Flavoured water	Iced tea
Flavour	Light (*n* = 191)	Zero-sugar (*n* = 191)	Low-energy, lemon and lime (*n* = 183)	Zero-sugar, blueberry (*n* = 187)	Low-energy, peach (*n* = 192)	Zero-sugar, lemon (*n* = 187)
				n (%) [a]		
Dislike very much	4 (2.1)	8 (4.2)	13 (6.8)	9 (4.7)	37 (19.3)	44 (22.9)
Dislike a little	11 (5.7)	14 (7.3)	36 (18.8)	13 (6.8)	20 (10.4)	39 (20.3)
Neither like nor dislike	51 (26.6)	59 (30.7)	37 (19.3)	17 (8.9)	61 (31.8)	44 (22.9)
Like a little	70 (36.5)	69 (35.9)	57 (29.7)	64 (33.3)	42 (21.9)	37 (19.3)
Like very much	55 (28.6)	41 (21.4)	40 (20.8)	84 (43.8)	32 (16.7)	23 (12.0)
Mean (SD)	3.84 (0.977)	3.63 (1.032)	3.41 (1.228)	4.07 (1.119)	3.06 (1.329)	2.76 (1.339)
t	11.93	8.48	4.52	13.13	0.65	−2.40
df	190	190	182	186	191	186
p-value	< 0.05[#]	< 0.05[#]	< 0.05[#]	< 0.05[#]	0.515[#]	0.017[#]

[a] *n* does not equal 192 in all columns as some participants did not answer; missing data were omitted in the statistical analyses; [#] one-sample *t*-test; df = degrees of freedom; *t* = test statistic; mean = average score, which is tested against the neutral rating of '3' [1 = dislike very much; 2 = dislike a little; 3 = neither like nor dislike; 4 = like a little; 5 = like very much]; SD = standard deviation.

Table 2: Consumer rating of the sound of the RSSB samples

Sample number	1	2	3	4	5	6
Type of RSSB	Soft drink	Soft drink	Squash	Sports/energy drink	Flavoured water	Iced tea
Flavour	Light ($n = 185$)	Zero-sugar ($n = 183$)	Low-energy, lemon and lime	Zero-sugar, blueberry	Low-energy, peach ($n = 171$)	Zero-sugar, lemon
				n (%) [a]		
Dislike very much	6 (3.1)	8 (4.2)	Not applicable*	Not applicable*	27 (14.1)	Not applicable*
Dislike a little	7 (3.6)	22 (11.5)	Not applicable*	Not applicable*	15 (7.8)	Not applicable*
Neither like nor dislike	74 (38.5)	81 (42.2)	Not applicable*	Not applicable*	101 (52.6)	Not applicable*
Like a little	58 (30.2)	46 (24.0)	Not applicable*	Not applicable*	19 (9.9)	Not applicable*
Like very much	40 (20.8)	26 (13.5)	Not applicable*	Not applicable*	9 (4.7)	Not applicable*
Mean (SD)	3.64 (0.968)	3.33 (1.006)	Not applicable*	Not applicable*	2.81 (1.006)	Not applicable*
t	9.03	4.41	Not applicable*	Not applicable*	−2.43	Not applicable*
df	184	182	Not applicable*	Not applicable*	170	Not applicable*
p-value	$< 0.05^{\#}$	$< 0.05^{\#}$	-	-	$0.016^{\#}$	-

* RSSBs do not have effervescence; [a] *n* does not equal 192 in all columns as some participants did not answer; missing data were omitted in the statistical analyses; [#] one-sample *t*-test; df = degrees of freedom; *t* = test statistic; mean = average score which is tested against the neutral rating of '3' [1 = dislike very much; 2 = dislike a little; 3 = neither like nor dislike; 4 = like a little; 5 = like very much]; SD = standard deviation.

and zero-sugar soft drink (mean = 3.33 ± 1.006; $p <$ 0.05), but not the flavoured water (mean = 2.81 ± 1.006; $p = 0.016$) (Table 2).

Consumer acceptance of the smell of RSSBs

Table 3 indicates the consumer rating of the smell of the RSSB samples.

The consumers liked the smell of the light soft drink (mean = 3.79 ± 1.058; $p <$ 0.05); zero-sugar soft drink (mean = 3.32 ± 1.172; $p <$ 0.05), and the sports/energy drink (mean = 3.63 ± 1.318; $p <$ 0.05), but not the iced tea (mean = 2.43 ± 1.366; $p < 0.05$) (Table 3).

Consumer acceptance of the taste of RSSBs

Table 4 indicates the consumer rating of the taste of the RSSB samples.

The consumers liked the taste of the light soft drink (mean = 3.73 ± 1.261; $p <$ 0.05); zero-sugar soft drink (mean = 3.28 ± 1.343; $p = 0.005$), and sports/energy drink (mean = 3.46 ± 1.457; $p <$ 0.05). However, the consumers disliked the taste of the flavoured water (mean = 2.05 ± 1.309; $p <$ 0.05) and the iced tea (mean = 2.31 ± 1.485; $p <$ 0.05) (Table 4).

Overall consumer acceptance of RSSBs

Table 5 indicates the consumer rating of the overall acceptability of the RSSB samples.

Overall, the consumers liked the light soft drink (mean = 3.69 ± 1.116; $p <$ 0.05), zero-sugar soft drink (mean = 3.26 ± 1.223; $p = 0.005$), and sports/energy drink (mean = 3.51 ± 1.361; $p <$ 0.05) but not the flavoured water (mean = 2.28 ± 1.259; $p <$ 0.05) and iced tea (mean = 2.33 ± 1.428; $p <$ 0.05) (Table 5).

Table 3: Consumer rating of the smell of the RSSB samples

Sample number	1	2	3	4	5	6
Type of RSSB	Soft drink	Soft drink	Squash	Sports/ energy drink	Flavoured water	Iced tea
Flavour	Light ($n = 192$)	Zero-sugar ($n = 190$)	Low-energy, lemon and lime ($n = 190$)	Zero sugar, blueberry ($n = 190$)	Low-energy, peach ($n = 190$)	Zero-sugar, lemon ($n = 190$)
				n (%) [a]		
Dislike very much	5 (2.6)	16 (8.3)	40 (20.8)	17 (8.9)	30 (15.6)	66 (34.4)
Dislike a little	23 (12.0)	30 (15.6)	40 (20.8)	29 (15.1)	31 (16.1)	44 (22.9)
Neither like nor dislike	32 (16.7)	52 (27.1)	35 (18.2)	24 (12.5)	49 (25.5)	31 (16.1)
Like a little	79 (41.1)	61 (31.8)	43 (22.4)	58 (30.2)	51 (26.6)	30 (15.6)
Like very much	53 (27.6)	31 (16.1)	32 (16.7)	62 (32.3)	29 (15.1)	19 (9.9)
Mean (SD)	3.79 (1.058)	3.32 (1.172)	2.93 (1.399)	3.63 (1.318)	3.09 (1.294)	2.43 (1.366)
t	10.37	3.78	−0.67	6.55	1.00	−5.74
df	191	189	189	189	189	189
p-value	$< 0.05^{\#}$	$< 0.05^{\#}$	$0.501^{\#}$	$< 0.05^{\#}$	$0.314^{\#}$	$< 0.05^{\#}$

[a] *n* does not equal 192 in all columns as some participants did not answer; missing data were omitted in the statistical analyses; [#] one-sample *t*-test; df = degrees of freedom; *t* = test statistic; mean = average score which is tested against the neutral rating of '3' [1 = dislike very much; 2 = dislike a little; 3 = neither like nor dislike; 4 = like a little; 5 = like very much]; SD = standard deviation.

Table 4: Consumer rating of the taste of the RSSB samples

Sample number	1	2	3	4	5	6
Type of RSSB	Soft drink	Soft drink	Squash	Sports/energy drink	Flavoured water	Iced tea
Flavour	Light ($n = 192$)	Zero-sugar ($n = 192$)	Low-energy, lemon and lime ($n = 192$)	Zero-sugar, blueberry ($n = 191$)	Low-energy, peach ($n = 191$)	Zero-sugar, lemon ($n = 192$)
				n (%) [a]		
Dislike very much	13 (6.8)	26 (13.5)	44 (22.9)	30 (15.6)	98 (51.0)	86 (44.8)
Dislike a little	30 (15.6)	35 (18.2)	41 (21.4)	28 (14.6)	35 (18.2)	38 (19.8)
Neither like nor dislike	17 (8.9)	31 (16.1)	24 (12.5)	18 (9.4)	18 (9.4)	16 (8.3)
Like a little	68 (35.4)	60 (31.3)	42 (21.9)	55 (28.6)	30 (15.6)	26 (13.5)
Like very much	64 (33.3)	40 (20.8)	41 (21.4)	60 (31.3)	10 (5.2)	26 (13.5)
Mean (SD)	3.73 (1.261)	3.28 (1.343)	2.97 (1.488)	3.46 (1.457)	2.05 (1.309)	2.31 (1.485)
t	8.01	2.85	−0.24	4.32	−10.00	−6.42
df	191	191	191	190	190	191
p-value	< 0.05[#]	0.005[#]	0.809[#]	< 0.05[#]	< 0.05[#]	< 0.05[#]

[a] *n* does not equal 192 in all columns as some participants did not answer; missing data were omitted in the statistical analyses; [#] one-sample *t*-test; df = degrees of freedom; *t* = test statistic; mean = average score which is tested against the neutral rating of '3' [1 = dislike very much; 2 = dislike a little; 3 = neither like nor dislike; 4 = like a little; 5 = like very much]; SD = standard deviation.

Table 5: Consumer rating of the overall acceptability of the RSSB samples

Sample number	1	2	3	4	5	6
Type of RSSB	Soft drink	Soft drink	Squash	Sports/ energy drink	Flavoured water	Iced tea
Flavour	Light ($n = 189$)	Zero-sugar ($n = 188$)	Low-energy, lemon and lime ($n = 189$)	Zero-sugar, blueberry ($n = 187$)	Low-energy, peach ($n = 186$)	Zero-sugar, lemon ($n = 186$)
				n (%) [a]		
Dislike very much	7 (3.6)	20 (10.4)	39 (20.3)	22 (11.5)	68 (35.4)	81 (42.2)
Dislike a little	26 (13.5)	33 (17.2)	33 (17.2)	27 (14.1)	49 (25.5)	29 (15.1)
Neither like nor dislike	35 (18.2)	43 (22.4)	39 (20.3)	27 (14.1)	27 (14.1)	29 (15.1)
Like a little	71 (37.0)	63 (32.8)	38 (19.8)	55 (28.6)	33 (17.2)	27 (14.1)
Like very much	50 (26.0)	29 (15.1)	40 (20.8)	56 (29.2)	9 (4.7)	20 (10.4)
Mean (SD)	3.69 (1.116)	3.26 (1.223)	3.04 (1.434)	3.51 (1.361)	2.28 (1.259)	2.33 (1.428)
t	8.54	2.86	0.36	5.16	−7.80	−6.37
df	188	187	188	186	185	185
p-value	< 0.05[#]	0.005[#]	0.723[#]	< 0.05[#]	< 0.05[#]	< 0.05[#]

[a] *n* does not equal 192 in all columns as some participants did not answer; missing data were omitted in the statistical analyses; [#] one-sample *t*-test; df = degrees of freedom; *t* = test statistic; mean = average score which is tested against the neutral rating of '3' [1 = dislike very much; 2 = dislike a little; 3 = neither like nor dislike; 4 = like a little; 5 = like very much]; SD = standard deviation.

Availability and accessibility of RSSBs

Seven out of 16 (43.8%) brands of soft drinks, one squash out of 9 (11.1%), and two out of 10 (20.0%) sports/energy drinks were available at all 10 MRGS. Amongst the available RSSBs, one flavour of a soft drink was the most accessible as it took up the most shelf space (mean = 1 773.90 cm ± 3 199.93 cm) and was situated at all shelf levels (top, middle, and bottom), at all the MRGSs. Second to this was a brand of squash, which took up an average of 1 255.20 cm shelf space and was displayed at middle shelf level (eye-level) in all MRGSs (Supplementary material, Appendix A1).

Discussion

Vision is the most powerful sense used in marketing. It plays a significant role in consumers' perception of a brand and influences their purchasing decisions.[21] In the current study, consumers assessed the colour, dullness, and transparency of the samples. Good appearance in an RSSB leads to appetite stimulation and acceptance.[21] Soft drinks are the most popular SSBs on the South African market,[20] explaining why consumers may have liked the appearance of the soft drinks (light and zero-sugar). Consumers also liked the appearance of the squash and the sports/energy drink. The squash was lime green, while the sports/energy drink was blue, both of which are bright colours. Consumers normally opt for bolder colours of beverages as they have an increased perception of sweetness and quality.[22] The appearance of the iced tea (dull brown colour, mimicking weak black tea), was disliked by the consumers. Consumers tend to like food/beverage colours that are associated with sweet-tasting foods (e.g. bright blue for fresh blueberries), while disliking those that are associated with bitter-tasting foods (e.g. brown/green vegetables and/or rotting foods).[22] Furthermore, iced tea is relatively new to the South African market as it was introduced in 2010 and is not as popular as soft drinks, energy drinks, and squashes.[20]

The effervescence of a beverage allows the consumer to predetermine what the beverage will taste like and creates expectations of how enjoyable it will be.[23] Consumers are more accepting of soft drinks with effervescence, while 'flat' soft drinks are perceived as low quality.[23] The sound of the light and zero-sugar soft drinks was liked by the consumers in line

with the fact that the sound of soft drinks is well known and used as a marketing tool by SSB companies.[23] The market for flavoured water has been growing in recent years. In addition, flavoured water has been marketed as a healthier substitute for soft drinks and is perceived as less 'boring' than still water, due to the effervescence.[23] However, despite this, the sound of the flavoured water was disliked by the consumers. Carbonated water is the least stable carbonated beverage due to its lack of viscosity and surfactant substances.[23] An increased effervescent sound in carbonated water can increase consumers' acceptability.[23]

The fact that smell is strongly linked to memory makes it a strategic tool for creating connections to a brand.[21] The smell of SSBs may bring back memories of social life and/or childhood as consumers may come across a particular fragrance reminiscent of those moments.[21] It may be possible that the consumers in the current study liked the smell of the soft drink and sports/energy drink because they grew up drinking it. The unpopularity of iced tea could explain why the smell was disliked by the consumers. Consumers may be unable to link the smell of iced tea to a memory because they may be unfamiliar with the product.

The taste of RSSBs contributes to their success in the market and is the top purchase driver for consumers.[22] Consumer taste testing of a zero-sugar RSSB was done by a large beverage company in SA. This company stated that the zero-sugar RSSB delivers a good taste that closely corresponds to their original product.[9] The zero-sugar and light soft drinks used in the current study have an effervescence, which creates a tingly sensation in the mouth and accents the flavour of the RSSB.[23] Consumers prefer the taste of sugar over NNS, so the type of NNS used in RSSBs impacts on the product's taste.[22] A combination of aspartame and acesulfame potassium comes closer to the mouthfeel perception provided by sugar than the use of a single sweetener.[22] The NNSs used in the zero-sugar and light soft drinks were aspartame, acesulfame potassium, and sucralose. Consumers liked the taste of the sports/energy drink, which contains sucralose and sodium saccharin. Sucralose is derived from sugar and closely resembles its taste.[24] Furthermore, it does not have a bitter after-taste like some NNSs and is 600 times sweeter than sugar.[24] The consumers disliked the taste of the flavoured water and the iced tea. The flavoured water did not contain any NNSs, but the sugar content was lower than that of the original product. Humans have an innate liking for sweetness, so the removal of sugar from a beverage will have a negative impact on its taste.[22] A study done in the United States of America (USA) found that consumers did not like the taste of sugar-reduced flavoured water and preferred sugar as a sweetener.[25] In a South African study, consumers disliked the taste of iced tea, because of its overt 'plant-like' note.[26]

There may be a broad consumer acceptance of the sweeteners used in RSSBs.[16] As consumers become more familiar with reduced-sugar products, their expectations and sensitivity to flavour differences have likely adjusted, reducing the impact of variations between RSSB types.[16] This could explain why, in the current study, there were no RSSBs that were significantly liked or disliked in terms of the overall acceptance and taste.

The average failure rate of introducing RSSBs to the market is 35%.[27] Sales of an RSSB may be high when the new product is launched because consumers are eager to try it. However, as the novelty diminishes, some consumers switch back to SSBs.[27] Energy drink sales are growing in SA and the trend is expected to continue due to urbanisation, interest in new flavours, reduced sugar options, and tactical marketing.[11,15,28] Consumers want sports/energy drinks to support their busy lifestyles with refreshment, good taste, and an energy boost.[15] Sports/energy drinks are also relatively affordable, highly available, and acceptable to the working-class and learner demographic, which makes up the majority of South Africans.[15,28] Soft drinks have been rated the most consumed SSBs worldwide.[29] In 2022, a survey conducted in SA outlined that soft drinks were the preferred type of SSBs with almost 90% of respondents indicating a preference for soft drinks.[29] Flavoured water and iced tea are not as popular as soft drinks and energy drinks on the South African market.[20] The flavoured water segment started to emerge about a decade ago, as consumers looked to water as a healthy alternative, or began to limit soft drink consumption.[25] Additionally, South Africans have not received adequate nutrition education on selecting healthier beverage choices.[15] Unsweetened iced tea can help consumers meet their daily water requirements as it contains 99.5% water.[29] South African consumers would not generally choose iced tea if there were other soft drinks available.[29]

Major retail grocery stores strategically place RSSBs in fridges and on shelves to meet consumer needs and maximise sales.[8] The refrigeration section is for immediate consumption and impulse buying, while the shelf section provides a larger selection of RSSBs and in bulk amounts.[8] From observation during data collection, there was a wider range of RSSBs available in the shelf area compared with the fridges. In the current study, the soft drink and squash took up the most shelf space, indicating that they were the most popular and fast-moving RSSBs at the time of the study.[10] Furthermore, they were displayed at eye-level and on multiple shelf levels, making them highly accessible.[10] As more consumers purchase SSBs, the more available they will become at MRGSs.[30] Due to the struggling South African economy, consumers are choosing SSB brands that offer quality at lower prices.[9] Soft drink sales are high on the South African market,[9] and the reformulated versions were the most available and accessible in the current study. Soft drinks are highly available and accessible in SA because they are affordable, refreshing in the warm South African climate, heavily marketed, culturally ingrained, and preferred for their sweet taste.[9] Squashes were also highly available and accessible as they are becoming increasingly popular due to their affordability.[9] They are generally cheaper alternatives to other beverages with good flavour and functionality.[9] Squashes also have a longer shelf-life and are convenient as they can be prepared anytime, anywhere.[9] Squashes are very popular in SA and are considered a staple in South African homes.[20] Between 2021 and 2023, there was a surge in the sales of sports/energy drinks in Africa, attributed to the large young population, urbanisation, and rapid lifestyle changes.[28] This is reflected in the current study because sports/energy drinks were among the most available RSSBs. Soft drinks, sports/energy drinks, and squashes are profitable products for MRGSs.[9] Their relatively low cost and long shelf-life make them easy to stock and sell in retail settings.[9] In addition, they are highly visible in MRGSs, making them easy for consumers to access regularly, especially in urban areas.[9]

Study limitations

Although squash should be prepared and consumed immediately for optimal flavour,[19] the squash dilution was not done minutes before the sensory evaluation as recommended, for logistical reasons.

Conclusion

Consumers accepted the reformulated versions of soft drinks and energy drinks, which are the most widely consumed SSBs in SA. Furthermore, soft drinks, sports/energy drinks, and squashes were the most available and accessible RSSBs in PMB MRGSs. The results are positive because these RSSBs were among the top-selling SSBs in 2021. Reformulated SSBs are widely available and accessible at MRGSs, enabling consumers to purchase and consume beverages with a reduced sugar content. The wide availability of RSSBs at MRGSs means that consumers are more likely to purchase them. Therefore, by purchasing and consuming more RSSBs, consumers are likely to be consuming less sugar overall. This study has indicated that there is potential for reduced sugar intake from RSSBs, in support of the HPL, indicating a positive public health impact.

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