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Improving soya mince recipes in the National School Nutrition Programme in South Africa

Carmen Muller, Maricia Margrit van Deventer, Beulah Pretorius and Hettie Carina Schönfeldt
Department of Animal Science, Natural and Agricultural Sciences, University of Pretoria, Pretoria, South Africa
carmen.muller@up.ac.za

The National School Nutrition Programme (NSNP) in South Africa provides thousands of needy children with school meals on school days. One, and in some cases 2, of these meals per week are soya based. A review of the NSNP revealed that many children do not eat on those days because they find the soya mince meal unappetising. As the meal served within the NSNP may be the only meal these learners receive during a day, it is essential to ensure learners' willingness to consume the meal, and, therefore, that the meal is made appetising and nutritious. During visits to 3 schools in the Tshwane district, interviews were conducted with school meal handlers. Information gathered from these sessions was used to develop 4 new recipes that fall within the guidelines and budget of the NSNP. The final recipes were beef bolognaise soya mince, chicken curry soya mince, chilli con carne soya mince and one-pot soya mince biryani. To evaluate the acceptability of these newly developed recipes, a sensory panel of 100 university students that formed part of the NSNP during their schooling years was assembled. The sensory evaluation was done by comparing the existing soya mince meal with the 4 new soya mince recipes. One of the new soya mince meals was found to be the preferred dish and was rated significantly higher in acceptability than the original soya mince meal.

Keywords: acceptability; school feeding; sensory evaluation; soya mince

Introduction

Worldwide, infants, children and adolescents are among the most vulnerable population groups. They are subject to irreversible short- and long-term cognitive, physical, and psychosocial consequences of hunger and malnutrition (Kristjansson, Petticrew, MacDonald, Krasevec, Janzen, Greenhalgh, Wells, MacGowan, Farmer, Shea, Mayhew, Tugwell & Welch, 2007). School feeding (the provision of food on-site or to take home) aims to increase school enrolment, attendance, and to prevent drop-out (Aliyar, Gelli & Hamdani, 2015). Many countries in the world have a school feeding programme to provide meals or snacks to children. It is estimated that globally more than 368 million schoolchildren are provided with school meals on a daily basis (Drake, Fernandes, Aurino, Kiamba, Giyose, Burbano, Alderman, Mai, Mitchell & Gelli, 2017) and that the total annual budget may be as much as $75 billion. School feeding also functions as a social safety net for households with very low incomes. Additionally, locally grown school feeding programmes aim to develop these economies by providing a source of income for small-scale farmers (Aliyar et al., 2015; Amegah, 2020).

The 2010/2011 Stats SA Income and Expenditure Survey (IES) and the 2014/2015 Living Conditions Survey (LCS), which are both the most recent surveys of their type, found that the percentage of total household expenditure spent on food and non-alcoholic beverages ranged from approximately a third of the total expenditure for the poorest 40% of the population to just over 5% for the wealthiest 10% of households (Statistics South Africa [Stats SA], 2017). The impact of the rising cost of food, along with escalating poverty levels is evident among lower income households that are already spending a large portion of their income on food. About 60% of the South African population, estimated at 60 million, according to the socioeconomic measurements, fall within the lower income category (Stats SA, 2022). This highlights the dire need for school feeding programmes that serve these communities who struggle to put food on the table.

Low concentrations of iron and zinc in the diet and body have been linked to a short attention span in children (Lai, Cai, Feng, Shek, Yap, Tan, Chong, Godfrey, Meaney, Rifkin-Graboi, Broekman & Chong, 2021). Higher test scores were also seen on days that children received the adequate amount of food (Florence, Asbridge & Veugelers, 2008). In 2019, in a study of primary school learners in Makurdi, Nigeria it was found that poor food quality, low quantity of food and irregular provision of meals had a significant impact on the academic outcomes of the learners (Nguvan, 2019).

School feeding schemes have proven to enhance school attendance and learner's academic outputs. As these meals are, for some learners, the only daily meal they receive it not only provides them with vital nutrients but also draws them to school. This is even more so in the case of female learners (United Nations, 2015). The design of school feeding in countries undergoing nutrition transition (westernisation of traditional diets), especially those in low- and middle-income countries, may provide some knowledge and experience on how to shift from providing sufficient energy (calories) to promoting healthy diets and dietary behaviour. The meals served at schools are invaluable to learners and ensuring that these meals are firstly edible, but also appealing is essential in optimising school feeding schemes and nutritional outcomes (Drake et al., 2017).

Literature Review

Schools are viewed as a cost-effective platform for providing safe and effective health interventions to school-aged learners. Many of the adverse conditions that are most prevalent among poor learners and that have important effects on education, such as absenteeism, grade repetition, or poor academic performance, are treatable or even preventable. Schools can reach an unprecedented number of children, as schools are at the heart of all communities. For this reason, societies have the opportunity to use schools as a sustainable option for simple health care and service delivery (Awojobi, 2019; Bundy, Schultz, Sarr, Banham, Colenso & Drake, 2017).

Standards, guidelines and policies in high-income countries have been recommended to combat rising levels of overweight and obesity and to promote healthier lifestyle habits. However, in low-income countries guidance on nutrition standards and guidelines for establishing and maintaining effective feeding programmes are lacking. Providing evidence-based guidelines on nutrition standards to middle- and low-income countries can potentially greatly enhance and improve the quality of service and the life of millions of children globally (Aliyar et al., 2015). Such guidelines would include aspects such as menu planning, budget allocation, quality of food, food preparation, food storage, meal preparation, hygiene, food safety, and sensory evaluation of foods to prevent wastage because of learners' rejection thereof.

Nguvan (2019) found that sustainability, i.e., the quality, quantity, and frequency of food provided, had a significant impact on the academic performance of primary school learners in the Makurdi town in Nigeria.

According to Amegah (2020), school feeding managers and school caterers ought to earn their positions on merit and should be given performance contracts. This will ensure that the meals are served and the quality, which has frequently been questioned in the countries where the school feeding programme is politicised, will improve tremendously, as managers and service providers will be held accountable.

The South African National School Nutrition Programme (NSNP) was introduced by the government in 1994 as part of the Reconstruction and Development Programme of the newly founded democratic Republic of South Africa (RSA). The NSNP provides school meals to needy learners and has been shown to improve punctuality, regular school attendance, concentration, and the general well-being of learners. The main objectives of the programme are to: (1) contribute to enhanced learning through school feeding; (2) strengthen nutrition education in schools in order to promote healthy lifestyles; (3) promote sustainable food production initiatives in schools; and (4) develop partnerships to enhance the programme (Department of Basic Education [DBE], RSA, 2020).

Upon its inception, the NSNP covered only learners in primary schools. The survey by the Fiscal and Finance Committee of the Minister of Finance undertaken in 2006 indicated that there was also a need for the programme in secondary schools, which was subsequently introduced in October 2008. Since its inception, the programme has reached more than 9,000,000 learners in 9,393 quintile 1, 2 and 3 primary and secondary schools. Quintile 1 to 3 schools are located in the most disadvantaged areas and receive all their school funds from the government (DBE, RSA, 2020).

Conceptual Framework

According to the *Report on the Implementation Evaluation of the National School Nutrition Programme* review, published in 2016 by the Department of Health, it was found that learners ate less on days that soya mince was served (Department of Planning, Monitoring and Evaluation & Department of Basic Education, 2016). One of the main complaints was that the soya mince meal lacked flavour and was unappetising. In the NSNP menu implemented in 2019, soya mince is served at least once in a 5-day school week in Gauteng (DBE, RSA, 2020). The overarching aim of this study was to find alternative soya mince recipes that would be more acceptable to learners regarding appearance, taste, smell, and feel in the mouth. The study also had as one of its objectives the development of new low-cost soya mince recipes that learners might prefer, and which may therefore improve the sustainability of the programme.

Methodology

A quantitative, semi-experimental study was conducted using a three-step approach. After sufficient background information was gathered by means of a semi-structured interview, recipe development and sensory evaluation were done.

School Visits

For the school visits, the Tshwane school district in the Gauteng province was selected, based on convenience as well as Gauteng being one of the provinces that regularly serves soya as part of their menu. The Tshwane school district is divided into three sub-districts by the Gauteng DBE. Three secondary schools were randomly selected from within each sub-district, namely Tshwane North, Tshwane South, and Tshwane West. Secondary schools were chosen for the study since a follow-up sensory study with undergraduate university students was planned. Secondary school learners and most undergraduate students are in the same age bracket (15–24 years) (World Health Organization, 2020). The percentage of individuals aged between

18 and 24 still attending secondary school was higher for those from households in the poorer income groups (quintiles 1 and 2) (Stats SA, 2022).

A semi-structured interview was conducted with each school principal and each NSNP coordinator involved in the implementation of the NSNP at the selected schools. The semi-structured interviews were guided by a set of questions that comprised both open-ended and closed questions. These interviews were recorded and transcribed for referencing purposes.

The three schools were visited over a 2-week period on days that were convenient for the respective principals and coordinators.

Recipe Development

Information gathered from the school visits prompted the need for new and improved soya recipes that would be appealing to the learners as the soya that is currently served is unappealing and subsequently wasted. Recipe development was conducted by an expert recipe development team using the triple-test method, which takes into consideration the guidelines on recipe development for subjects with limited resources (Miller, Burgess & Mason, 1999; Reed & Schuster, 2002). These criteria specify that recipes should (1) use low-cost, readily available ingredients; (2) be easy to read and follow; (3) use basic equipment and appliances; (4) be successfully tested by a minimum of three people; (5) be nutritious and tasty; (6) be flexible so that the same basic recipe can be used with fresh, frozen, or canned food varieties; and (7) have a limited number of ingredients.

Once the researchers and recipe developers were well versed on the resources available at the schools, criteria for recipe development were established. Four recipes were developed and the dishes prepared, namely a beef bolognaise soya mince meal, a chicken curry soya mince meal, a chilli con carne soya mince meal, and a one-pot biryani soya mince meal. This was followed by a pilot sensory evaluation study by chefs (n = 4), university students (n = 6) and researchers (n = 5), to ensure that the recipes developed were appealing prior to upscaling. The recipes were adapted following the recommendations of the pilot study and thereafter the recipes were triple tested. During triple testing, the recipes were prepared three times using the same method to ensure that consistent results were obtained. Recipes developed followed basic recipe standardisation guidelines, including specification of amounts and ingredients, as well as clear instructions and easy preparation actions to ensure repeatability and consistency (Miller et al., 1999; Reed & Schuster, 2002).

Consumer Sensory Panel

The importance of sensory evaluation with a target audience is to ensure acceptability within the audience to whom the product is aimed (Guinard, 2000). This can be ensured if sensory analyses are done on a similar target group (Hassanally, Naicker & Singh, 2020). Thus, the decision was made to test the five recipes (i.e., the original soy meal prepared according to the NSNP recipe as prescribed by the NSNP, a beef bolognaise soya mince meal, a chicken curry soya mince meal, a chilli con carne soya mince meal, and a one-pot soya mince biryani meal) on young adults between 18 and 20 years.

Consumer sensory testing was conducted at the sensory science laboratory facility at the University of Pretoria. In total, 120 students were recruited, of which 100 participated in the study. Recruitment was done through the University of Pretoria's sensory laboratory online database, which has 3,000 participants. The online system allows for campus-wide recruitment with specific parameters. Participants for this study were screened by means of home language (isiNdebele, Northern Sotho, Sesotho, siSwati, Xitsonga, Setswana, Tshivenda, isiXhosa and isiZulu) and age (18–20 years old) who completed school in the past 2 to 3 years.

Upon arrival at the sensory laboratory, participants were briefed by the programme administrator, who also handled all queries during the sensory evaluation session. Participants had to sign a consent form prior to being shown to their individual evaluation cubicles. Each cubicle was set up for individual sensory evaluation according to the standards of ASTM International[1] (formerly known as the American Society for Testing and Materials) to ensure participants were not able to communicate with one another, nor be exposed to external stimuli that might potentially affect their responses (ASTM International, 2020). Participants completed the sensory questionnaire using the Compusense Sensory Test Program (Compusense, 2020), which is a computerised sensory analysis tool. This program captures and analyses data in real time, and ensures simplistic, coordinated and efficient evaluation results.

Samples were served to each panellist through a double hatch in their individual booths. Once panellists received their samples, the Compusense programme prompted them on the order in which samples should be evaluated. Each panellist was served a tray containing five randomly coded samples, along with five spoons and water at room temperature as a palate cleanser. The five samples included the four newly developed recipes, as well as the current recipe recommended by the NSNP. Samples were served in 55 ml glass bowls containing 30 ml servings and covered with aluminium foil, marked with the sample code. Samples were kept in a bain-marie (double boiler) at 65 °C and served according to food safety standards.

The participants were given clear instructions and questions regarding each meal they received. Participants used a 7-point hedonic scale to assess

the overall liking, appearance, smell, taste, and texture in the mouth of every dish. The participants were able to provide a comment regarding each of the mentioned categories. A 7-point Likert scale was used to determine participants' willingness to consume the dish during their school years, and their perception regarding its resemblance to meat. Participants could also rank their choice of starch (i.e. rice, maize porridge, and pasta). Finally, the participants were asked a general question about whether or not they were familiar with the NSNP in South Africa. If they indicated that they were indeed familiar with the NSNP in South Africa, follow-up questions regarding the programme were asked.

Permission and Ethical Approval

Permission to visit and interview the respective school principals and NSNP coordinators was granted in writing by the Gauteng DBE. The University of Pretoria's Department of Community Engagement assisted with both the identification and initial contact with the schools. Ethical clearance was granted from the University of Pretoria to carry out the project (Ethical clearance number: GW2010605HS). Each school principal and NSNP coordinator was required to sign an informed consent form. Sensory panellists were also required to sign a consent form prior to being shown to their individual evaluation cubicles during the sensory evaluation.

Data Analyses

Data from the sensory evaluation were analysed using Compusense to calculate means, standard deviations and medians for different aspects of the sensory evaluations. A two-way analysis of variance (ANOVA) test was applied with Fisher's least significant difference (LSD) protected *t*-test at the 5% level of significance among cultivar means.

Results

School Visits

Although the three schools all form part of the same provincial department, and some elements are similar, the implementation and management of the NSNP are somewhat different at each school. Prepacked bags of soy chunks/mince are delivered to the schools. When the soy was prepared according to the preparation instructions on the back of the pack, this resulted in a slush that was not appealing to the eye.

Personnel Facilities and Suppliers

Each school visited had an NSNP coordinator (manager) who oversaw the programme. The coordinator was also a teacher employed at the school as stated in the NSNP guidelines (Department of Planning, Monitoring and Evaluation & Department of Basic Education, 2016). The NSNP coordinator was assisted by six or seven (ratio 1:200 per learner) food handlers, who were employed on a 2-year contract on the condition that they had a child in the school during the time of employment. These food handlers received a monthly stipend from the Gauteng DBE and training on how to prepare the meals according to the NSNP recipes. The Gauteng DBE had installed a three-gas burner stove at each school in an area indicated by the school. Although each of the NSNP schools were supplied with typical kitchen equipment, such as utensils and pots, much of the equipment was missing during the school visits. Fresh food deliveries were received once a week, and non-perishable items, such as soya, were delivered once a month. All schools had a dedicated lockable storeroom for the food. The key was held by a staff member other than the NSNP coordinator.

None of the schools visited had a formal dining area, and as a result food was served outside in a communal area. The schools highlighted this as a problem. None of the schools visited had any of the original plates and cutlery left that was supplied by the Gauteng DBE when the NSNP was implemented. The plates and cutlery were either damaged beyond repair, or were reported stolen. Some of the learners bring their own plates or containers to the school on a daily basis. Learners also have the option of buying a polystyrene container at cost.

Menu

All the schools follow the same guidelines and menu as set out by the Gauteng DBE and thus all the schools only serve the prescribed soya mince meal on Fridays (DBE, RSA, 2020). The soya mince meal is prepared as per instructions on the packaging.

Outside Vendors

Another similarity encountered at all schools was that independent vendors were allowed to enter the school premises and sell food during breaks or lunchtimes. In some cases, learners would take the starch portion provided by the NSNP (e.g. maize porridge, rice, bread) and buy a protein (e.g. chicken feet or meat stew) from a vendor to complement it. Vendors are allowed on the premises under the condition that they are responsible for cleaning the school yard after lunchtime. At schools where learners ate from polystyrene containers, there was notably more waste at the end of lunch, which the vendors needed to clean.

Take Home Meals

All the schools followed the initiative of sending food home to learners who requested that food be sent home over weekends or school holidays. This initiative was made possible due to careful planning by the school coordinator. The NSNP coordinators assess which food(s) is consumed and enjoyed the least on a given day, such as a Friday, when soy is served. On such a day, not all the food was prepared,

which allowed for food to be sent home to the learners in need.

Recipe Development

Once all the school visits were conducted and available resources at the various schools identified, the recipe development team developed four new soy recipes. The recipes were designed with the available facilities in mind, as well as recommendations made by the NSNP coordinator during the school visits. Recipes were developed to include ingredients that formed part of the NSNP with an allowance for substitution to bring variety to the meals. The addition of seasoning was incorporated as this was one of the recommendations that the schools made to make the meals more appealing.

The four recipes developed were: (1) a beef bolognaise soya mince meal; (2) a chicken curry soya mince meal; (3) a chilli con carne soya mince meal; and (4) a one-pot soya mince biryani meal. The beef bolognaise soya mince meal recipe was introduced to be served with pasta as it was learned that learners enjoyed pasta. Pasta is, however, not on the NSNP ingredients list, therefore the suggestion to add it can be made, or the recipe can be served with rice. Origanum that is not on the NSNP ingredient list, was also included in the recipe. The chicken curry soya mince meal introduced chicken-flavoured soya mince to be served with pap. Chicken flavour is currently not incorporated in the NSNP, but is available from the suppliers at the same cost. In addition to the different soya mince flavour, turmeric powder and medium curry powder were suggested to be included in the NSNP ingredient list. As many of the cooks indicated that the learners asked for flavouring and spice, a chilli con carne and rice recipe was developed, which brought both elements to the table. The recipe proposed the inclusion of sugar beans, medium curry powder, and a can of chakalaka (a spicy vegetable relish) to the ingredient list. The type of chakalaka can be decided on by the schools, depending on learner preference. The last recipe, as the name suggests, is made in one stewing pot from the start and includes lentils and Cape Malay style spice not on the current ingredient list. Biryani is a meat and rice dish popular in South Africa. The recipe will be made with beef soya mince meal, Cape Malay style spices, and rice.

It should be noted that the recipes did not include the texturized vegetable protein (TVP) as it is received by the schools. Prior to cooking, the TVP is sifted to separate the soy chunks from the powder additives. For the purpose of recipe development, a ratio of 70:30 soya mince to powder additives was used. This decision was made based on the idea that the powder additives contained some flavouring and thickeners.

Sensory Evaluation

The consumer sensory test panel was held at the University of Pretoria. In total, 100 students participated in the sensory testing, of which 22 were male and 78 female. Each participant was served five meals on a tray, i.e. the soya mince prepared according to the methods used by the schools and the four meals that were developed. The meal was served as it would be served in the NSNP with an accompanying starch. Each tray was individually packed and coded on a random basis, with codes generated by Compusense ensuring each participant received the samples in a different order to remove any form of comparison or bias. A palate cleanser (water at room temperature) and five spoons accompanied each tray. Statistical analyses were conducted and significant difference evaluated in accordance with the conventional acceptance of statistical significance at a p-value of 0.05 or 5%. Thus a confidence interval of 95% was used.

Table 1 summarises the results from the sensory panel, i.e. the overall mean liking of each dish based on the 7-point hedonic scale, with one donating *dislike extremely* and seven *like extremely*. There was a significant difference (Fisher, $p < 0.05$) between dishes with different subscripts. Although the likeability of the beef bolognaise soya mince meal (5.18), the chilli con carne soya mince meal (5.51) and the one-pot soya mince biryani meal (5.03) were higher than that of the chicken curry soya mince meal (4.25), the likeability of all the developed meals were significantly higher than that of the original soya mince meal (3.19). The original soy dish was the least preferred.

Questioning the students about their willingness or intent to purchase each meal (Table 1), significant differences were found between dishes. The beef bolognaise soya mince meal (4.10) scored significantly higher than both the chicken curry soya mince meal (3.26) and the original soya mince meal (2.28). The beef bolognaise soya mine meal (4.10) did not significantly differ in intent to purchase from the chilli con carne soya mince meal (4.02). The one-pot soya mince biryani had a mean significantly lower than that of the beef bolognaise soya mince meal (Fisher's LSM, $p < 0.05$), but similar to the chicken curry soya mince meal. However, all the meals scored significantly higher than the original soya mince meal.

Table 1 Sensory evaluation outcomes showing overall liking, intent to purchase and resemblance to meat

Soya mince meal	*Mdn*	*M**	*SD*
Attribute		Overall liking	
Original soy dish	3.00	3.19^{c}	1.57
Beef bolognaise	6.00	5.18^{a}	1.74
Chilli con carne	6.00	5.51^{a}	1.45
One-pot biryani	5.00	5.03^{a}	1.71
Chicken curry	5.00	4.25^{b}	1.81
Attribute		Intent to purchase	
Original soy dish	2.00	2.28^{d}	1.06
Beef bolognaise	4.50	4.10^{a}	1.06
Chilli con carne	4.00	$4.02^{a,b}$	1.12
One-pot biryani	4.00	$3.61^{b,c}$	1.30
Chicken curry	3.00	3.26^{c}	1.40
Attribute		Resembles to meat	
Original soy dish	4.00	3.65^{d}	2.24
Beef bolognaise	6.00	5.50^{a}	1.78
Chilli con carne	6.00	$4.87^{a,b}$	2.19
One-pot biryani	6.00	$4.53^{b,c}$	2.22
Chicken curry	4.00	$4.06^{c,d}$	2.21

Note. *Means with different superscripts per attribute differ significantly ($p < 0.05$).

In evaluating whether the soya mince resembled meat (Table 1), the participants were of the opinion that the beef bolognaise soya mince meal (5.50) and the chilli con carne soya mince meal (4.87) resembled meat significantly more than the chicken curry soya mince meal (4.06) or the original soya mince meal (3.65). The chilli con carne soya mince meal did not resemble meat significantly more than the one-pot soya mince biryani meal (4.53), which in turn did not significantly resemble meat more than the chicken curry soya mince meal. The chicken curry soya mince meal did not resemble meat significantly more than that of the original soya mince meal. Mean values were highest for the beef bolognaise soya mince meal, followed by chilli con carne soya mince meal, one-pot soya mince biryani meal and chicken curry soya mince meal, and the original soya mince meal. According to the rankings for choice of starch (Figure 1), the most popular starch was rice (ranked first by 54% of students), followed by pasta, and finally maize porridge, commonly called "pap."

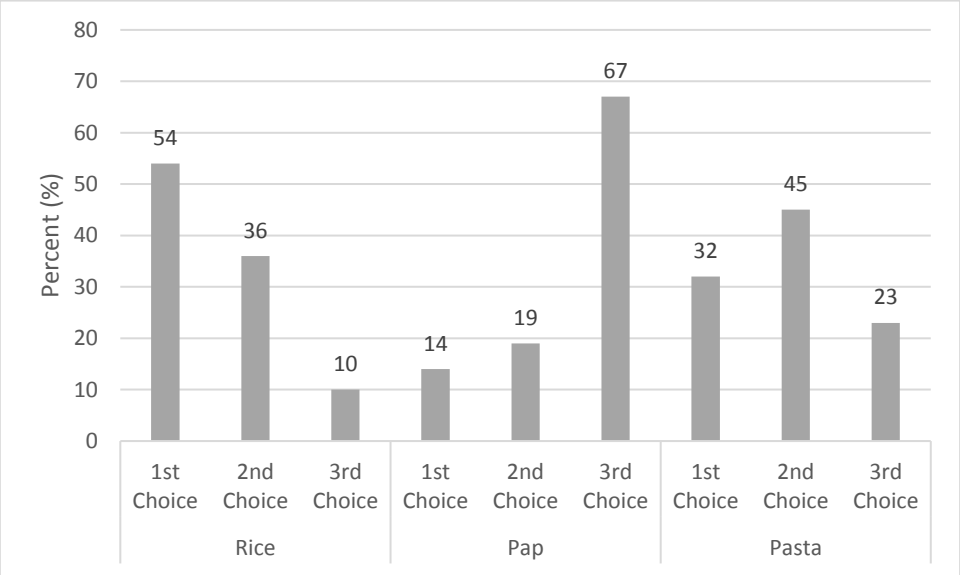

Figure 1 Starch ranking by choice

As mentioned earlier, students had the option to provide a reason for their like or dislike for each soya mince meal in terms of look, smell, taste, and feel in the mouth. Regarding the original soya mince meal currently served in the NSNP, students commented most on the look and taste of the meal. Some students gave short comments such as "*It was okay*" or "*It was too thick and salty. It lacked flavour.*" Three students, however, gave detailed reviews, quoted here verbatim:

> *I hated it. On days that it was I rather opted to stay hungry and dizzy instead of eating it. There were other days though where they would cook it and it did not taste as bad or maybe I was just too hungry on those days. Just know that I and many other people hate the soy meals. We would rather eat the green soup with bread over soy.*
>
> *The soy meals served it was bland and only had a slight taste to it. It was runny with no thick texture to it. It was mostly served with pap or rice and because of its' runny texture it would just spill over the starch. Most learners only ate the food, because it was the only meal they got to eat, and therefore they did not pay much attention to how it tasted. Some learners would vomit because they could not stomach the runny texture of the soy meal.*
>
> *At our school, they did not pay attention to how it tasted. They just cooked it blandly and we would just eat the Soy soup out of hunger. They did not spice it up and always just cooked it the same way. The difference would be that at the top it was very watery*

and towards the bottom it was chunky and did not look like soup.

The chilli con carne soya mince meal came out as the overall favourite (*n* = 81), with positive comments. More than 30 students gave positive feedback, two students felt that the meal did not look appetising, and the remaining students did not comment. All the feedback received on the aroma of the meal was positive, including those who gave the meal a low score on the hedonic scale. Some students commented that the meal was too spicy for their personal taste but most students enjoyed the taste, with one student commenting that the meal tasted as if it contained "*real mince.*" The negative reviews that were received about the mouth feel was that the sugar beans in the chilli con carne soya meal were crunchy or hard to chew. This was also raised in the general comment section. The feeling regarding the meal was good otherwise and one student commented that he would pay for the meal. Additional cooking of the sugar beans is proposed as it would improve the texture of the meal.

The beef bolognaise soya mince meal received good comments overall (*n* = 73). Most students liked the look and smell of the meal commenting that the meal looked appealing, appetising and that it smelled "*incredible.*" The general consensus was that the taste of the meal was good and the students enjoyed the flavour. Students also enjoyed the mouthfeel, with comments such as "*The texture of the dish is amazing, nice and soft.*" Not all students enjoyed the soft feel, as one student commented that the texture was comparable to "*mashed baby food*." Regarding the general comments, students indicated that the meal was "*not bad*" and the pasta was a great addition since it is not currently served in the NSNP.

The one-pot biryani soya mince meal, which ranked third, was generally well received (*n* = 69), yet some students did not like the presentation of the meal commenting "[a] c*oncern is the presentation, it was difficult to tell what is the meal*." A few students did not enjoy the aroma, whereas other students gave positive reviews and added that it smelled like "*something delicious*." Students did enjoy the overall taste of the meal and one student compared the meal to a risotto. A few students did make comments regarding the lentils and that another ingredient could have been used without suggesting which ingredient. Although some students also did not like the feel of the lentils in the mouth, the overall meal received positive comments in this category. When asked for general comments, students indicated that they liked that all the ingredients were mixed together with some students still indicating that the lentils were not a good addition.

Lastly, the chicken curry soya mince meal was not as well received by the students (*n* = 51). For the meal, chicken flavoured soya mince was used instead of the beef flavour. This was done to test whether chicken would be better received. Results showed that although it did not score as low as the original NSNP meal students thought that the overall look was not appetising, and one student commented that it "*looks like pap and pumpkin*." The overall aroma of the meal was also not well received nor was the taste. Once again students wanted more flavour. The overall comments regarding the feel in the mouth was not negative and students enjoyed the texture. Generally, the students did not enjoy the chicken flavour soya mince and it was evident that the beef flavour soya mince was the best choice for the NSNP.

Discussion

During the school visits and from the review of the NSNP (Department of Planning, Monitoring and Evaluation & Department of Basic Education, 2016) it became clear that the learners did not like the soya mince meals as served in the NSNP in terms of look, taste, aroma, and mouthfeel. This resulted in considerable food wastage and cost to the government, with many children missing a meal.

Serving an appealing meal with limited resources and supplies requires planning and creative thinking. The newly developed recipes took the students' preferences as well as the schools' resources into consideration. As the meal served to these learners may be the only meal they will receive that day, it was essential to make it a meal that was both appetising and nutritious.

Previous sensory evaluation studies supported the notion that children react better to a food product with which they are familiar (Coulthard, Palfreyman & Morizet, 2016). This was supported by this project as the recipe that was made with chakalaka, i.e. the chilli con carne soya mince meal, was deemed to be the most favourable meal.

It was furthermore found that there was a general lack of knowledge regarding soya mince; the various ways in which soya mince can be prepared, as well as the contribution that soya mince can make to the diet. With this study we identified possible gaps for consumer education of the food handlers, teachers, and learners.

Limitations

Due to ethical constraints, sensory testing was not conducted with secondary school learners. However, to remediate this, university students that completed school in the past 2 to 3 years were the selected target audience. The study had limited geographical coverage as only schools within one district was investigated. During report back with the DBE, it was found that the problem was similar across the different provinces and that Gauteng could be used as a point of departure for school investigations.

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Authors' Contributions

CM – project PI, data capturing, article writing, article editing. MMD – fieldwork, data gathering, data capturing, article writing. BP – statistical analysis, article editing. HCS – article editing and review. All authors reviewed the manuscript.

Notes

i. ASTM International is an international standards organisation that develops and publishes voluntary consensus technical standards for a wide range of materials, products, systems, and services (ASTM International, 2020).

ii. Published under a Creative Commons Attribution Licence.

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