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HIDDEN FOOD SAFETY ATTRIBUTES AND SENSORY EVALUATION OF FOOD SERVED UNDER MID-DAY MEAL SCHEME IN KHAMANON BLOCK, DISTRICT FATEHGARH SAHIB, PUNJAB (INDIA)

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ABSTRACT

The mid-day meal scheme began in India with the goal to eradicate hunger for millions of children and to contribute to their education, nutrition and health. However, it has not achieved the goal at the desired pace to meet the Millennium Development Goals. This study was conducted in 11 government schools of Khamanon block of district Fatehgarh Sahib, Punjab (India). It is a cross sectional study in which the sample size of 336 was calculated based on the prevalence of malnutrition. The hidden, quasi-hidden and sensory attributes of food served under mid-day meal scheme in Khamanon block were examined. The results revealed that uric acid levels were above the PFA standards for wheat and rice (>1%) while aflatoxins levels were within the permissible limits. Less than 10% weevil infestation was observed in wheat, rice and green gram, one week after storage. There were no rodent infestations in food grains. Broken count of food grains was < 10%. No foreign materials such as animal faeces or fur were found in the samples. Significant differences were noted during sensory evaluation of cooked meals in different schools. The study showed that mid-day meal provided to the students fulfils the recommended daily requirement of a child, but there is a need to improve some of the contents of meal. For example, the fat content was low, and leafy vegetables were deficient. There is a need to improve the quality and nutritional aspects of mid-day meal.

Keywords: Food safety, mid-day meal, quasi-hidden attributes, sensory quality

INTRODUCTION

The National Program of Nutritional Support to Primary Education was launched in 1995 to enhance the enrolment and attendance in schools, and to improve the nutritional levels by providing a cooked mid-day meal (MDM) to the students studying in classes I-V in government and aided-schools (Prasad *et al.*, 2013). The MDM scheme focuses on to improve the interest of children in school attendance as well as provide them with one-time daily nutritional requirement. It is observed that India has not attained the set goals at the required pace to meet Millennium Development Goals (NFHS 4). Despite concerted efforts to improve the health of school students, the services provided in India tend to fall short, largely due to the scarcity of resources and facilities (Meal, 2010). Various reports on MDM scheme reveal ignorance about quality management standards in MDM scheme. Greater emphasis on food safety was introduced only after an incident in Bihar in 2013 where almost 23 children died of poisoning after consuming the food provided under this scheme (Reuters, 2013).

Food safety an important aspect of ensuring good health which is largely neglected and requires immediate attention. World-wide almost 1 in 10 people fall ill after consuming contaminated food which results in a loss of 33 million healthy life years with nearly 40% of food-borne disease burden in under-5 children (WHO, 2018). Food safety, food security and nutrition are inseparably linked. Unsafe food creates a vicious cycle of diarrhea and malnutrition, threatening the nutritional status of the most vulnerable class. The burden of food-borne diseases has often been underestimated due to underreporting where local incidents can quickly evolve into international emergencies affecting lakhs of people (WHO, 2018). It is, therefore, mandatory to periodically evaluate the nutritional quality of meals served to the school children for nutrient content and hidden food attributes. Lack of nutrients in food may lead to diseases and lack of food safety is associated with presence of biological, chemical and (quasi) hidden physical hazards. In mid-day-meal scheme, biological food contamination is generally regularly monitored because of its known immediate consequences after food consumption but hidden food safety attributes are largely ignored or rarely studied. Therefore, the present study was aimed to evaluate the cooked and raw food for hidden food safety attributes with secondary focus on other qualities like sensory attributes and nutrient composition.

MATERIALS AND METHODS

Sample size

A cross sectional study of middle and higher secondary government/ municipality schools (6-8 class) was conducted in Khamanon block of district Fatehgarh Sahib (Punjab). Sample size of the students involved in present study was calculated by using the formula (Kirkwood and Sterne, 2010).

$$n = 4pq/d^2$$

where p = prevalence or proportion of the characteristic considered in the populace; q = 1-p and d = relative error in the estimated prevalence (standard error at 0.05 level).

Assuming 30% prevalence of malnutrition and 95% confidence interval, a sample size of 336 children was considered sound. Out of the total 112 operational schools in Khamanon block of district Fatehgarh Sahib, 10% schools were selected randomly (11 schools) by convenience sampling technique. The students were selected randomly from these schools. Study population included the students of both the Government and municipality schools. The study was initiated in December 2017 with the submission of protocol for the study. Data collection started in May to July 2018 with analysis in September- November 2018 and final printing in December 2018.

Data collection

Sensory quality testing of food was done by a panel of 8-10 judges (including the children) on 9-point hedonic scale (Lim, 2011). The prepared food was evaluated and accordingly the points were given. A pretested and approved questionnaire intended to capture the data relating to food and nutritive position of school children was also served (Padhi, 2012). The raw food samples were taken from the schools based on weekly menu of MDM scheme. The food samples were then taken to the food testing lab in Panchkula (Interstellar Testing Centre Pvt., Ltd, An ISO 9001 Certified & NABL Accredited Laboratory). The samples were tested for Quasi- and Hidden-food safety attributes. The presence of aflatoxins and uric acid were assessed.

Hidden food safety attributes

To assess the presence of uric acid on the outer-surface of grains (which demonstrates rodent action), 1 g food grains was absorbed in 10 mL de-mineralized double distilled water for 10-15 min to check the nearness of uric acid in tests utilizing Jaffe's reaction and then perused on a spectrophotometer (make and model) at 680 nm (Delanghe and Speeckaert, 2011). The aflatoxins (B_1, B_2, G_1 and G_2)

in raw food samples was measured by high performance liquid chromatography (HPLC) method (Azer, 1991).

Quasi-hidden food safety attributes

The sustenance tests were conducted for the general conditions of food including smell and infestations and additionally for the nearness of some injurious substance to human well-being rendering the grain unpalatable. The substances were blended and spread uniformly on a levelled smooth surface. From this spread 100 grains were taken and with the help of magnifying glass different refractions were gotten by hand. Care was taken to guarantee that each refraction was represented just once. Weevil drove and creepy crawly harmed or plagued grains were isolated and thoroughly checked. The sections were deliberately analyzed for nearness of rat hair or droppings in the sample. Additional dampness induces the chances of microbial and fungal growth. The grains were at first weighed and then kept in oven 60^0C. The moisture content was determined using the standard formula (Kraszewski, 1998).

$$M = \frac{mw \times 100}{mw + md}$$

where mw = mass of water, and md = mass of dry material.

The grain quality was assessed by measuring the physical characteristics of hundred raw food grains randomly selected from all the samples by manual examination. Length, width, colour and shape of the food samples was assessed.

Statistical analysis

A two-way ANOVA was conducted to examine the food quality of various schools by analyzing the various parameters of food served. All tests of significance were two-tailed and the level of significance taken at p-value <0.05 (Pillemer, 1991). Means were calculated for the measured dimensions of raw food samples collected.

RESULTS AND DISCUSSION

The sensory quality evaluation of MDM food served at different schools is given in Table 1. The means and SD of food samples from different schools were compared for various parameters (colour, consistency and taste) of food served in MDM. Significant ($p < 0.05$) effects were found for the main effect of schools, $F(10, 99) = 18.64$, $p = 0.00$ and the parameter into school interaction, $F(20, 99) = 2.51$, $p = 0.00$, but the main effect of parameters fall short of statistical significance, $F(2, 99) = 2.01$, $p = 0.31$. However, these main effects were qualified by a significant interaction between parameter and schools. There was significant difference in food quality of samples from different schools.

Table 1: Mean and standard deviation of food samples of different schools

School	Colour (mean ± SD)	Taste (mean ± SD)	Consistency (mean ± SD)
S1	7.00 ± 0.00	7.00 ± 0.00	6.75 ± 0.43
S2	7.00 ± 0.00	7.75 ± 0.43	7.75 ± 0.43
S3	6.75 ± 0.43	6.50 ± 0.50	5.50 ± 0.50
S4	6.25 ± 0.43	6.75 ± 0.43	6.50 ± 0.50
S5	5.75 ± 0.43	6.25 ± 0.43	6.50 ± 0.50
S6	6.50 ± 0.50	7.00 ± 0.00	7.00 ± 0.00
S7	6.75 ± 0.43	6.75 ± 0.43	5.75 ± 0.43
S8	5.50 ± 0.50	5.00 ± 0.00	5.00 ± 0.00
S9	6.25 ± 0.43	6.50 ± 0.50	6.50 ± 0.50
S10	6.50 ± 0.50	6.75 ± 0.43	7.00 ± 0.00
S11	6.25 ± 0.43	6.25 ± 0.43	6.50 ± 0.50

To explain the interaction, simple main effects analysis showed that there was significant difference in food

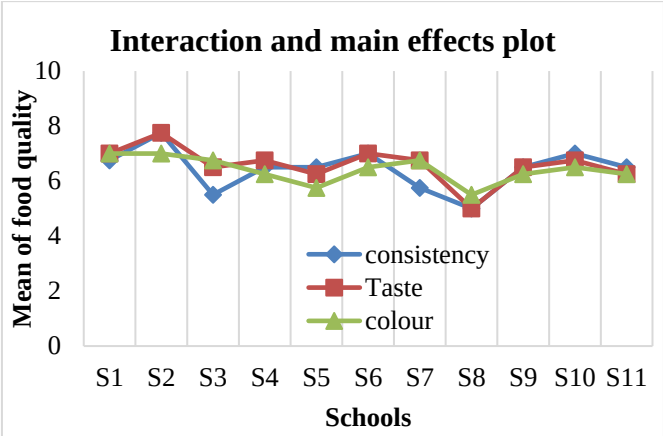

Fig. 1: Food quality of mid-day meals in schools

quality of different schools as school 1 and 2 (p = 0.00) , school 2 and 3 (p = 0.00), school 5 and 6 (p = 0.00), school 7 and 8 (p = 0.00), school 8 and 9 (p = 0.00), school 10 and 11 (p = 0.04) by comparing the colour, consistency and taste but there was no difference in the food quality of school 3 and 4 (p = 0.35), school 4 and 5 (p = 0.15), school 6 and 7 (p = 0.07), school 9 and 10 (p = 0.10). The food quality was of higher mark in the school 2 while the lowest was for the school 8 in terms of consistency, colour and taste (Fig. 1).

Hidden food safety attributes in MDM food

Physical characteristics of food grains: The mean length and width of different food samples (wheat, rice, green gram, split Bengal gram and black gram) collected from the schools were calculated. Colour and shape of grains were observed. The mean length of wheat was 6.4 ± 0.3 mm and width 3.1 ± 0.2 mm (Fig. 2). Shape of wheat grains was oval to long, narrow and flattened. Colour of grains was light yellow to brownish. The mean length and width of rice was 6.6 ± 0.2 and 1.9 ± 0.2 mm, respectively (Fig. 3). Shape of rice grains was cylindrical with colour varying from white to slightly yellow.

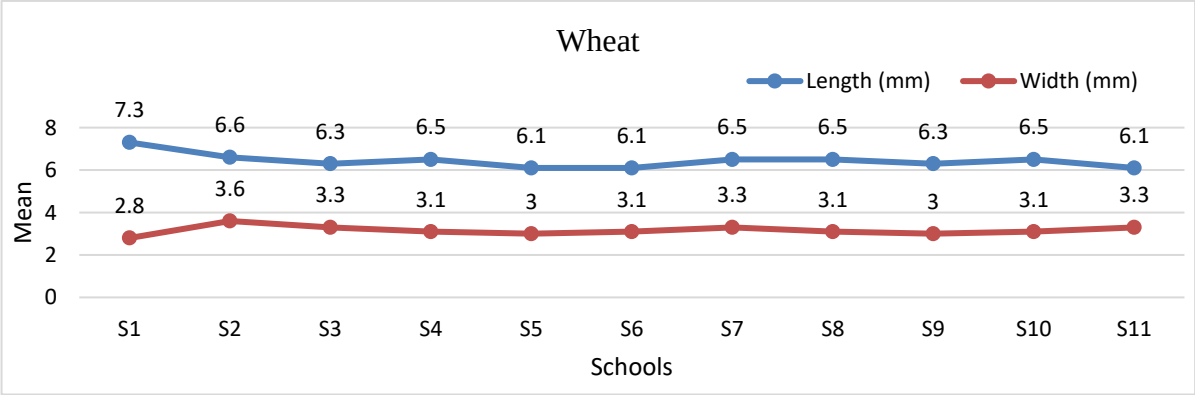

Fig. 2: Length and width of wheat samples for MDM

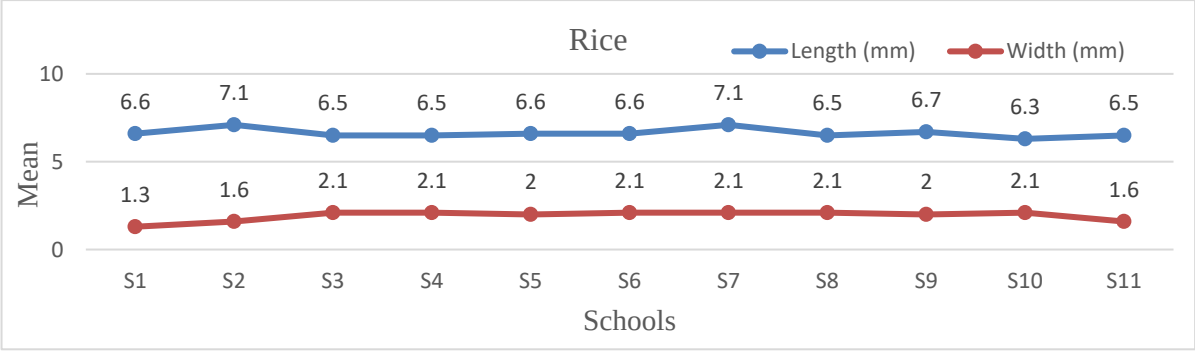

Fig. 3: Length and width of rice samples for MDM

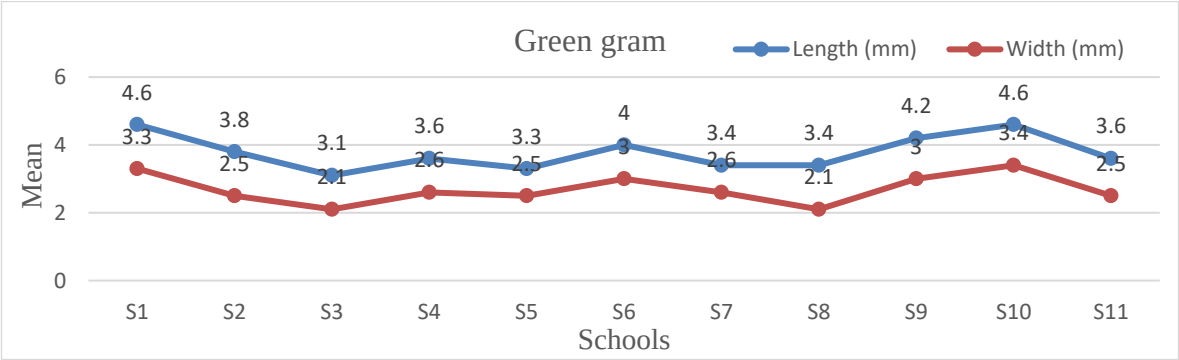

Fig. 4: Mean length and width of the green gram samples for MDM

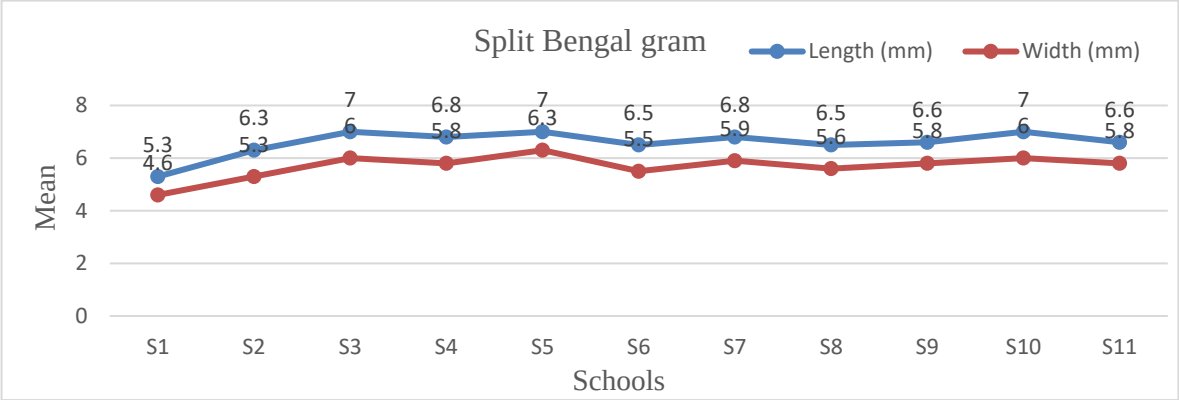

Fig. 5: Length and width of split Bengal gram samples for MDM

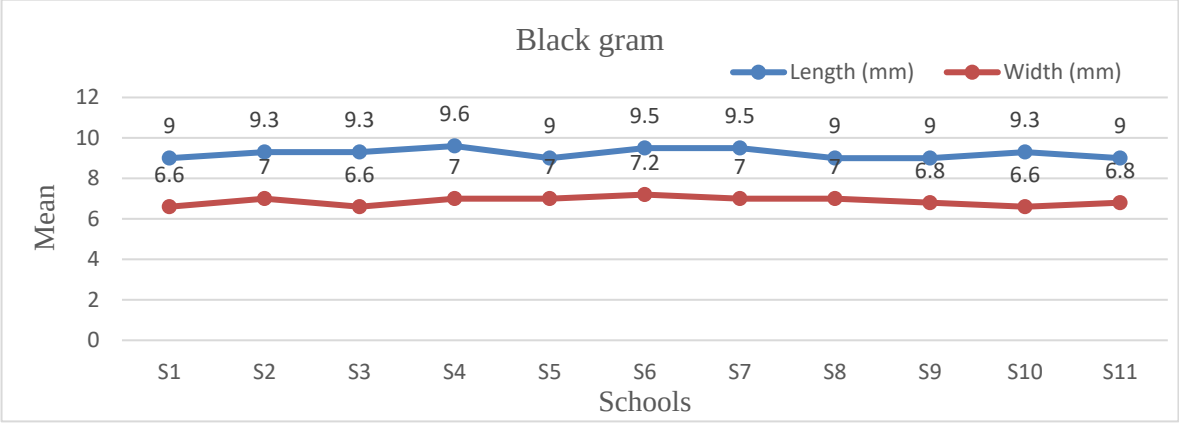

Fig. 6: Length and width of black gram samples for MDM

The mean length of green gram was 3.7 ± 0.4 mm and width 2.6 ± 0.4 mm unit^{-1} (Fig. 4). Shape of green gram lentil was mostly ovoid and colour dark green. Mean length and width of split Bengal gram 6.5 ± 0.4 and 5.6 ± 0.4 mm unit^{-1}, respectively (Fig. 5). Shape of gram was ovoid to round with bright yellow colour. Mean length and width of black gram was 9.2 ± 0.2 and 6.8 ± 0.1 mm unit^{-1}, respectively (Fig. 6). The shape of black gram was more like a leaf or angular with colour varying from dark brownish to black. The quality of pulses, cereals, spices, salt, etc. in present study was satisfactory in almost all the schools. Proper storage facilities were available. Weevil and rodent infestations were below the prescribed levels by PFA. Similar low quality of food grains and poor storage facilities results were reported in the joint review report of Andhra Pradesh and Madhya Pradesh schools. Low quality of the mid- day meal was found from many studies (Afridi, 2005; Kumari, 2009).

Hidden and quasi-hidden food safety attributes

The samples were examined for hidden and quasi- hidden attributes including moisture content (Table 2). The uric acid as well as aflatoxin levels were within the permissible limit of less than 1% (FSSAI, 2018). Infestation of weevil and broken count was also within the permissible limit. Moisture content was least for pulses (green gram). Aflatoxins and uric acid levels were within the permissible limits (< 30 mg kg^{-1} i.e. <1% and < 100 mg kg^{-1} i.e. <1%) (FSSAI, 2018). Problem of poor food quality of MDM has previously been reported by Deodhar *et al.* (2010) who found high levels of uric acid and aflatoxins in MDM. According to the joint review report of Himachal Pradesh, the quality of MDM was satisfactory but the count of broken grains was very high (MHRD, 2018).

Table 2: Hidden and quasi-hidden food safety attributes in food samples of MDM

Food	Uric acid (%)	Aflatoxin (mg kg^{-1})	Weevil infestation (%)	Broken grains (%)	Moisture content (%)
PFA* standards	< 100 mg kg^{-1} i.e. <1%	< 30 mg kg^{-1} i.e. <1%	< 10% by count	< 0.5%	< 14% by weight
Wheat	0.80	0.5	7.0	5.0	7.0
Rice	0.70	0.5	4.0	8.0	8.0
Green gram	0.83	0.5	3.0	2.0	6.5

*PFA: Prevention of Food Adulteration (FSSAI, 2018)

Conclusions: For running a healthy uninterrupted MDM program, it is very important to sustain food safety. By maintaining proper hygiene, many communicable diseases such as diarrhea can be prevented. So, school authority should be concerned about maintaining proper hygiene and meeting nutritional requirements and hidden food safety attributes. Though the outcome of the study terms of food safety was quite satisfactory, the prevalence of child malnutrition is still a major concern. There is a need for increased focus on the quality and nutritive content of the Mid-day Meal, so that an overall improvement can be seen.

Ethical statement: Ethical clearance to conduct the present study was obtained from PGIMER Intramural Ethical Committee vide No. INT/IEC/2018/000934 Dated 25/06/18. All ethical criteria were taken care of during data collection.

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