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Research Paper

Development of *sev* from Multigrain Mixes from Finger Millet Malt, Moth Bean Malt and Drumstick (*Moringa sp.*) Leaf Powder

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ABSTRACT

In this paper the effect of incorporation of multigrain mixes from finger millet malt and moth bean malt on the various physicochemical quality characteristics and sensory score of *sev* was evaluated. The *sev* was prepared by using the finger millet malt : moth bean malt at 16:36, 21:31, 26:26, 31:21, ; 36:16 respectively. The various quality characteristics i.e., Moisture%, Protein%, Fat%, Fibre%, Ash%, Carbohydrates%, oil uptake ratio, Calorific value, browning index along with the sensory attributes i.e. colour, flavour, texture, taste and overall acceptability of the developed *sev* was evaluated. Response surface analysis was performed with the quality attributes indicated that *sev* prepared with finger millet malt 26%, moth bean malt 26% and drumstick leaf powder results the best quality *sev* have best nutritional, textural and sensory qualities. The optimal product at quality consist of moisture content 1.809%, protein 12.588 %, fat 11.131%, fibre 1.253%, ash 2.063% and carbohydrate 68.334%, oil uptake ratio 1.87, hardness 23.66 N, browning index 142.25, calorific value 446.44 kcal/100g and have heighest sensory score higher colour 8.3, taste 8.8, Texture 8.5 and overall acceptability 8.5.

Keywords: Finger millet malt, moth bean malt, physicochemical quality and sensory analysis of *sev*

Sev is an Indian traditional snack food, most commonly prepared form pulse flour. It is a fried savory resembling *vermicelli*, can also be made from other legumes (such as black gram) and cereals (generally rice) singly and in blends (Annapure *et al*. 1998). Among the convenience foods, a major share of market belongs to the category of deep fried snacks. The origin of most of these products can be traced to the traditional practices of better preservation techniques for which, fried foods naturally became a choice due to their shelf stability (Kumari and Prakash, 2009). Snacks contribute an important part of many consumers in daily nutrient and calorie intake (Chakraborty *et al*. 2011).

Multigrain mixes prepare form various cereals and legumes like Chickpea (*Cicer arietinum*) or Bengal gram is valued for its nutritive with high protein content (20.8%), Ash(2.7%), fat(5.6%), fiber(15.3%) (Indrani, 2011). nutritive value of rice flour, moisture (14%), ash (0.6%), crude protein (9 %), crude fat (1%), and carbohydrate (77%) (Sacchetti, 2004). Nutritive value of wheat flour, moisture (13.3%), fat (1.8%), protein (10.7%), ash (0.7%), Carbohydrate (76%)

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(Ribotta *et al.* 2005). The consumption of cereals and legumes all over the world gives them an important position in international nutrition. Besides the high starch and protein content as energy source, these grains provide dietary fibre, nutritious protein and lipids rich in essential fatty acids. Important micronutrients present in cereals are vitamins, especially many B vitamins, minerals, antioxidants and phyto-chemicals (Itagi and Singh, 2012). Coarse cereals includes wheat, rice, finger millet (Eleusine coracana), These are also termed as nutricereals because of their nutritional properties (Bouis, 2000). these nutricereals are rich sources of minerals (phosphorus, magnesium, manganese, zinc, copper, iron and selenium), essential vitamins (thiamin, vitamin B6, niacin, riboflavin, folate, vitamin A and vitamin E), protein, carbohydrates, dietary fibers and certain compounds such as phenolics which provides *sev*eral health benefits such as proper nutrition, increased vigor against diseases and some immunomodulatary effects (Kaur *et al.* 2012).

Finger millet (*Eleusine Coracana*) also known as *ragi*. the grains are staple cereal food in some parts of Africa and India (Siwela *et al*. 2010). Finger millet belongs to the family *Poaceae* and originated in Ethiopia (Shiihii *et al*. 2011) before reaching India (Siwela *et al*. 2010). Globally, finger millet is estimated to be cultivated on an area of 4–4.5 million hectares, with a production of about 4.5 million tonnes (Guarino, 2012). The finger millet growing states in India, the highest production was obtained from Karnataka (1.2 million ton), followed by Tamil Nadu (0.224 million ton), Uttarakhand (0.174 million ton), Maharashtra (0.138 ton) and Andhra Pradesh (0.040 million ton) (Ganapathy and Patil, 2017). Finger millet is generally rich in dietary fiber and micro nutrients to prepare flour and the whole meal is utilized in the preparation of traditional foods, such as *roti* (unleavened breads), *ambali* (thin porridge) and *mudde* (dumpling) (Devi, 2014). Nutritional value of finger millet, i.e moisture (13.1g), protein (7.3g), fat (1.3g), minerals (2.7g), fiber (11.5g), carbohydrates (72.0g), carotene (42mg), thiamine (0.42mg), riboflavin (0.19mg), niacin (1.1mg) (Shobana *et al.* 2013). Finger millet contains low amounts fat which contributes to reducing risks of diabetes mellitus and gastro-intestinal tract disorders (Muthamilarasan *et al*. 2016). Starch extracted from finger millet grains are used in the pharmaceutical industries in the preparation of granules for tablets and capsule dosages (Shiihii *et al*. 2011). Finger millet malt is superior to other millet malts and it is ranked next to barly (Malleshi and Desikachar, 1986). The malted and fermented ragi flour are extensively used in preparation of weaning food, instant mixes, beverages and pharmaceutical products (Rao and Muralikrishna, 2001).

Moth bean (*Phaseolus aconitifolins*) are one of the legume consumed in Northern India (Mankotia and Modgil, 2017). They are important source of proteins, carbohydrates including fiber, certain minerals (Ca, Mg, Zinc, Iron, Potassium and Phosphorus) (Salve and Mehrajfatema, 2011). Nutritive value of Moth bean (*Vigna aconitifolia*) i.e protein (24.9%), fat (1.48%), crude fiber (4.5%), ash(2.8%), carbohydrate (60.1%) (Wabkhede and Ramteke, 1982). Legumes are generally consumed after processing into various products like milling into "*dhal*" puffing or roasting into snack foods, grinding into flour for different food preparations (Villegas *et al.* 2008). Starch is the major component of moth bean. Like other plant foods the digestibility of moth bean starch may also be limited by cell wall structural features (Tovar *et al*. 1991). Food legumes constitute the integral part of the diet in the Indian subcontinent. Annual production of moth bean in India 2.41 lakh ton and Maharastra 1.25 lakh ton (Kumar and Singh, 2002). The moth bean incorporated products *holige, masala vadai, nucchinundae, payasam, kharasev* were prepared by replacing the main pulse used in the basic recipe at 50 per cent level and papad at 100 per cent (Asha *et al*. 2005). Moth bean seeds have medicinal value and are used in the diets of patients suffering form fevers (Adsule, 1996). The sprouted and cooked grain is preferred as breakfast item. Fried dehusked splits are consumed in the from of dalia, a ready to eat product (Nimkar *et al*. 2005). Germination is one of the most common processes for improving the nutritional quality of pulses, not only by the reduction of antinutritive compounds also increase protein content, dietary fiber, vitamin, bioavailability of trace elements and minerals (Kaushik *et al*. 2010).

Drumstick *(Moringa oieifera),* known as miracle tree and native plant to the southern foothills of the Himalaya India, and is grown in tropical and subtropical countries and is well known for its health benefits. Leaves, flower and the fruits (popularly known as drumstick) are being used in traditional food preparation (Vanajakshi *et al.* 2015). It is the most widely cultivated species of *Moringaceae* family. Commonly it is known as in English–moringa or drumstick tree or horseradish tree, in hindi-*sahjan*, in latin- *moringa oleifera*, in Sanskrit -*surajana*, in nepali - *sajiwan* or *swejan* etc. It is useful not only for human beings but also for animal and also in various industrial application (Patel *et al.* 2010). Yield of leaves is approximately 55.73-15.73 tone's per hectare (Foidl *et al*. 2007). The leaves contain 7.5 mg water, 6.7 mg protein, 1.7 mg fat, 14.3 mg total carbohydrate, 0.9 mg Fibre, 2.0 mg ash, 440 mg Calcium, 70 mg Phosphorous, 7 mg Iron, 110 mg Copper, 5.1 mg, 11.300 mg vitamin A, 120 mg vitamin B, 0.8 mg nicotinic acid, 220 mg ascorbic acid and 7.4 mg tocopherol per100 mg (Fahey, 2005). Leaves of *M. Oleifera* could be used for stomach complaints, cancer, gastric ulcers, skin diseases, lowering blood sugar, increasing bone density, nervous condition, diabetes, fatigue, increase lactation, hay fever, cramps, headaches, sore gums; to strengthen the eyes and the brain, liver, gall digestive, respiratory and immune system and as a blood cleaner and blood builder (Patel *et al*. 2010). Ready-to-eat extruded snack food product prepared from multigrain mixes i.e., rice flour, wheat flour, Bengal gram and guava grit flour (Sarangam *et al*. 2017). Extruded prepared from rice and horse gram blend (Gat and Ananthanarayan *et al*. 2015). Chakraborty *et al*. (2009) reported that redy- to-eat extruded snack prepared from mixes (barnyard millet and red gram) In the present investigation *sev* mixes from finger millet malt and moth bean malt is prepared, the quality analysis of the *sev* prepared from these mixes have also been studied.

MATERIALS AND METHODS

Raw material

Raw materials of Finger millet (*Eleusine coracana*) and moth bean *(Phaseolus aconitifolins*) were procured from local market, Roha Dist-Raigad (Maharastra State) and drumstick leaves were procured from the farmers field at Roha. The leaves will be washed with tap water to remove dirt, dust.

Development of Finger millet malt and moth bean malt

The finger millet malt was prepared as per the procedure described by Swami *et al.* (2013). Finger millet grain of *Dapoli*-1 variety was brought from the local market Roha, The grains were cleaned. Finger millet grains were soaked in the water 1:3 for 12hr at normal atmospheric temperature. The water was drained out and the soaked grains were placed in a muslin cloth and allowed to germinate for 24 hours. The germinated sample was removed from moist cloth after 24 hr and placed in a tray dryer at 50˚C and dried up to 6 hr. Dried sample after removal of root heads was milled in the hammer mill (Make: M/ Sagar Engineering work, Kudal (India)) up to 4.541×10^{-4} mm particle size.

The moth bean malt was prepared as per the procedure by Rana and Kaur, 2015. Moth bean grain *ladia* variety was brough from local market of Roha. The grains were cleaned and made free from dust as well as other foreign materials then seed were soaked in the water 1:3 for 12 hours. The water was drained out and the soaked grains were placed in a muslin cloth and allowed to germinate for 12 hours. The germinated sample was removed from moist cloth after 12h and placed in a tray dryer at 50˚C dried up to 8 hrs. dried sample after removal of root heads was milled in the hammer mill (Make: M/ Sagar Engineering work, Kudal (India)) up to 5.4×10^{-3} mm particle size.

Formulation of multigrain mixes

The dried flour of finger millet malt and moth bean malt were used to formulate multigrain mixes. The formulations were made with finger millet malt and moth bean malt the concentration of finger malt : moth bean malt was varied as 16:36, 21:31, 26:26, 31:21 and 36:16 respectively. The other ingredient with seasoning of spices, cumin 3%, chilli 1%, salt 2.6%, garlic 1%, drumstick leaf powder 1% and grain like gram flour 10%, wheat flour 10%, rice flour 18% respectively were considered 48 % remains same in all formulations. Table 1 shows various levels of experiment using the multigrain mixes.

Table 1: Experimental level of multigrain mixes for *thalipeeth*

Sl. No.	T1	T2	T3	T4	T5
Finger millet malt (%)	16	21	26	31	36
Moth bean malt (%)	36	31	26	21	16
Other ingredients (%)	48	48	48	48	48

Other ingredients are drumstick leaf powder 1%, wheat flour 10%, rice flour 18%, chickpea flour 10%, chili 1%, cummin 3%, garlic1%, salt 2.6%.

Preparation of *sev*

All the ingredient given in Table 1 was used to prepared *sev* from treatment T_1, T_2, T_3, T_4 and T_5. The flour combination from treatment T_1 to T_5 was mixed separately with water and dough was prepared. The dough consistency should be a little softer then the *roti* dough.

Mixing the multigrain mixes (T_1, T_2, T_3, T_4, T_5) with water

⬇

Soft Dough was formed and knead

⬇

Put flat-bottomed pan on medium-high flam

⬇

Add refined vegetable oil

⬇

When oil is hot

⬇

Extruded of sev in the oil (hand operater extruder)

⬇

Deep fry these shev a few time on medium flame

⬇

Till they attain a brown colour and turn crispier

Fig. 1: Process flow chart for preparation of *sev* from multigrain mix

The dough was filled with small extruded (*chakli* maker/*sevai* maker) of 1-2 mm size opening and extruded the dough with the help of hand presser. Extruded *sev* was fried in hot refined vegetable oil in large *kadhai*. The frying was done of 3-4 minutes and the *sev* was taken out of the edible oil when the colour of the extruded *sev* change from yellow brown colour.

Physico-chemical analysis of *sev* from multigrain mixes

1. Moisture Content

The moisture content of *sev* for treatment T1 – T5 were determined by AOAC (2010). 10 g sample of the *sev* was taken for determination of moisture content in to each three different moisture boxes. The initial weight of moisture box was recorded. The samples were exposed to 105˚C ± 1˚C for 24 hr. in a hot air oven (Make M/s: Aditi Associate, Mumbai. Model: ALO-136). The final weight was recorded. The moisture content of the sample were determined by equation (1). The experiment was repeated four times and average ready was reported.

$$\text{Moisture content \% (db)} = \frac{W1 - W2}{W2} \times 100 \quad \ldots(1)$$

Where,

*W*1= weight of sample before drying.

*W*2= weight of sample after drying.

2. Protein

Protein content in the *sev* was determined for treatment T1 – T5 determined by a micro-Kjeldahl distillation method (AOAC 1990). The samples were digested by heating with concentrated sulphuric acid (H_2SO_4) in the presence of digestion mixture, potassium sulphate (K_2SO_4) and copper sulphate (C_uSO_4). The mixture was made alkaline with 40% NaOH, Ammonium sulphate thus formed were released ammonia which was collected in 4% boric acid solution and titrated again with standard HCL. The percent nitrogen content of the sample was calculated the formula given below equation (2). The experiment was repeated four times and average reading was reported.

$$\% (N) = 1.4 \times (\text{ml HCl} - \text{ml blank}) \times \text{Conc. of } \frac{HCL}{Weight} \text{ of sample (g)} \quad \ldots(2)$$

% Protein = % N × Factor (6.25).

3. Fat (%)

Fat contain of sample *sev* was for treatment T1 – T5 determined using soxhlet fat extraction system (AOAC, 2010). In this method, initially weight of empty flask was weighed. 2g of sample was wrapped in filter paper. It was kept in siphoning tube and condenser was fixed above it and siphoned for 9 to 12 times with the petroleum ether in soxhlet apparatus. After removing assembly, evaporation of petroleum ether was allowed by heating round bottom flask. Residue reminder at the bottom of the flask and was reweighed with flask. The quantity of residue was determined as fat content of multigrain mixes and *sev*. Fat content was calculated by using equation (3). The experiment was repeated four times and average ready was reported.

$$\% \text{ Fat} = \frac{Final\ weigh - Initial\ weight}{Weight\ of\ sample} \times 100 \quad \ldots(3)$$

4. Fibre (%)

Fibre contain of *sev* for treatment T1 – T5 was determined using about 2 – 5 g of moisture and fat free sample was weighed into a 500 ml beaker and a 200 ml of boiling 0.25 N sulphuric acid was added to the mixture and boiled for 30 min keeping the volume constant by addition of water at frequent intervals. The mixture was filtered through a muslin cloth and then transferred to the same beaker and 200 ml of boiling 0.313 N (1.25 %) NaOH was added, after boiling for 30 min, the mixture was filtered through muslin cloth. The residue was washed with hot water till it is free from alkali, followed by washing with alcohol and ether. It was then transferred to crucible, dried overnight at 80^{0}C to 100^{0}C and weighed. The crucible was heated in muffle furnace at 525^{0}C for 2 – 3 hrs, cooled and weighed again. The difference in the weights represented the weight of crude fibre equation (4) Rangana, (1986). The experiment was repeated four times and average reading was reported.

$$\text{Crude Fiber} \left(\frac{g}{100g}\right) = \frac{\begin{array}{c}100 - (\text{Moisture} + \text{Fat}) \times \\ \text{Weight of Fiber Weight}\end{array}}{\begin{array}{c}\text{Weight of sample taken} \\ (\text{Moisture} + \text{Fat free sample})\end{array}} \times 10 \quad \ldots(4)$$

5. Ash (%)

Ash content of sample *sev* for treatment T1 – T5 was calculated using muffle furnance. 5 g of sample was taken in crucible. Weight of crucible and sample was recorded and kept in muffle furnace at 525 ºC for 4 -5 h till constant weight was achieved. The crucible was cooled in desiccators and final weight of ash and crucible was recorded. Ash content was calculated by using equation (5). The experiment was repeated three times the average ash content was reported.

$$\text{Ash content (\%)} = \frac{(W2 - W1)}{(weight\ of\ sample)} \times 100 \quad \ldots(5)$$

Where,

W_2 = weight of crucible + ash,

W_1 = weight of empty crucible.

6. Carbohydrates (%)

The carbohydrate content of *sev* were calculated from protein, fat, fibre, ash and moisture content by using equation (6) (Adegunwa *et al*. 2012);

Carbohydrates = 100 – (protein + fat + fiber + ash + moisture content … (6)

7. Colour

The *sev* as per treatment T_1-T_5 were used to measure the colour value using a colorimeter (M/s Konica Minolta, Japan Model- Meter CR-400). The equipment was calibrated against standard white tile. Multigrain mixes and *sev* were taken in the petri dish, the petri dish was placed at the aperture of the instrument. The colour was recorded in terms of *L*= lightness to darkness; *a* = Redness to Greeness ; *b* = yellowness to blueness.

The whiteness index (WI) was determined for multigrain mixes.

Whiteness index was calculated by the following equation (7) of Park, (1994):

$$\text{Whiteness index} = [(100 - L)]^2 + a^2 + b^2]^{1/2} \quad \ldots(7)$$

The browning index (BI) was determined for *thalipeeth* browning index of the *thalipeeth* was calculated by the following equation (8) reported by (Perez *et. al.*, 2006).

$$B_I = \left(\frac{100 \times (x - 0.31)}{0.172}\right) \quad \ldots(8)$$

$$x = \frac{a * + 1.75L}{5.645L + a - 3.012b} \quad \ldots(9)$$

Where,

L = lightness (100) to darkness (0)

a = redness (+60) to Greeness (-60)

b = yellowness (+60) to blueness (-60)

8. Texture

The Hardness of the *sev* from finger millet malt, moth bean malt and drumstick leaf powder was determined by Texture Analyser (Make: M/s Food Technology Corporation; Model: TMS Touch). in Dept. of Fish Processing Technology and Microbiology, College of Fisheries DBSKKV Shiragaon campus Dist. Ratnagiri. A spherical probe with 5mm/sec of pre-test speed and post-test speed was 1 mm/s and 20% compression and 5 g trigger force was taken for hardness analysis is two- bite test, which includes the first compression cycle. The force vs. time data during the first compression of the product by instrumental probe was recorded by the instrument parameter obtained for each test through the equipment were hardness. The experiment was performed 3 times for the replication and average data was presented for *sev* of each combination finger millet malt : moth bean malt i.e. 16, 31, 26, 36, 21%, 36, 21, 26 and 16, 31%.

9. Calorific value (kcal/100g)

Calorific value of sev for treatment T1, T2, T3, T4, and T5 for multigrain mixes from finger millet malt and moth bean malt as follows. Calculation method involved multiplication of percent fat, protein and carbohydrates (excluding dietary fiber) by their physiological energy change coefficients (as full energy of combustion is not available in human body), i.e., 9.0, 4.0 and 4.0 kcal/g, respectively, followed by their subsequent addition (FAO, 2003) Total calories of the *sev* were calculated by the formula of James as follows:

$$\text{Total calories} = \text{Fat} \times 9 + \text{protein} \times 4 + \text{Total carbohydrate} \times 4 \quad \ldots(10)$$

10. Oil uptake ratio

The uptake ratio (UR) for *sev* was calculated from the moisture content of dough and *sev* and fat content of *sev* using the formula given by Pinthus *et al*. (1993).

$$\text{Oil uptake ratio } (U_R) = \frac{Fat\ content}{M_D - M_P} \quad \ldots(11)$$

M_D - moisture content of dough (%)

M_P - moisture content of *sev* (%)

Fat content of *sev* (%)

11. Sensory Evaluation

The sensory attribute of *sev* for treatment T1 – T5 was evaluated with semi-trained panelists. The panelists were trained for the product testing and were familiar with product sensory evaluation. *Sev* samples were placed in plates. The *sev* prepared from all the treatments and control sample were coded from A to F there were around 6 different samples out of which 5 no. of samples were from the different treatments and one treatment was of control. Which were made from various treatment combinations T1

Table 2: Physico-chemical properties of *sev*

SL. No.	Parameter	T1	T2	T3	T4	T5	SE (±)	CD at p≤0.05
(a)	Protein	14.422±0.206	14.712±712	15.410±410	15.175±0.527	14.621±0.556	18.794	56.653
(b)	Fat	10.830± 0.340	10.333±0.065	11.131±0.623	10.483±0.351	10.488±0.338	0.863	2.601
(c)	Moisture content	1.268±0.060	1.394±0.044	1.809±0.225	1.625±0.047	1.462±0.531	0.584	1.760
(d)	Fiber	1.0832±0.191	1.003±0.001	1.253±0.473	1.016±0.019	1.016±0.130	0.527	1.589
(e)	Ash	1.113±0.126	1.178±0.105	2.063±0.410	1.306±0.245	1.372±0.458	0.681	2.055
(f)	Carbohydrate	71.283± 0.944	72.000± 0.585	68.334± 1.379	70.397±0.903	71.041±1.282	2.366	7.132
(g)	Browning index	158.00±0.438	156.580±1.472	142.251±0.743	155.312±0.300	151.882±0.315	4.896	14.759
(h)	Uptake ratio	1.963±0.375	2.305±0.420	1.870±0.437	2.422±1.567	1.775±0.621	1.830	5.219
(i)	Hardness	22.57±1.414	15.71±1.500	23.66±1.291	15.11±1.291	13.94±2.160	3.500	10.550
(j)	Calorific value	451.936±1.098	448.964±2.423	446.440±1.706	451.243±2.163	450.387±3.275	5.039	15.1898

and T5 as given in Table 2. The sensory parameters i.e. colour, taste, texture and overall acceptability were evaluated based on the Nine-point hedonic scale and the attribute were summed up for total score of each panelist the data were analyzed statistically for the significant of each attribute by ANOVA.

12. Correlation of the quality parameter i.e. subjective and objective tests

The optimum product quality of *sev* was determined based on the desirable quality attribute i.e., *sev* should have more protein, more fat, more fibre, more ash, more carbohydrate was compared with the best sensory attribute, the best treatment were judged by the sensory panellist. The best treatment was decided based on two and correlated the optimum product quality with the subjective quality evaluation.

RESULTS AND DISCUSSION

This chapter includes results of experimental observations and discussion based on these results. It includes Development of *sev* from multigrain mixes with levels and incorporation as finger millet malt: moth bean malt (16:36%, 21:31%, 26:26%, 31:21%, 36:16%). Physico-chemical properties of *sev* from multigrain mixes are reported.

Protein

The Fig. 2 shows the protein content for *sev* using finger millet malt and moth bean malt. The protein content was in the range of 14.42 to 15.17 %, it was 14.42, 14.71, 15.41, 15.17, 14.62 % for treatments T_1, T_2, T_3, T_4, and T_5 respectively.

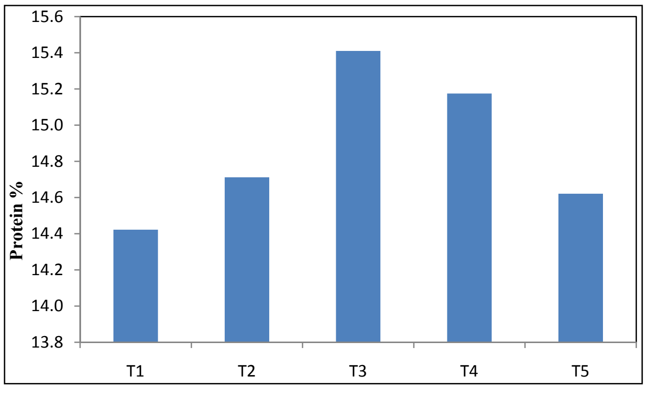

Fig. 2: Effect of various treatments combination (T_1-T_5) of FM malt and MB malt on protein content on *sev*

The highest protein content was observed for treatment T_3 and lowest protein content was observed at treatment T_1. As the finger millet malt was increased and moth bean malt decreases from treatment T_1 to T_5 the protein content shows gradually increase upto T_3 followed by decreasing trend. Bordin *et al.*

(2013) reported that protein is increased by the frying process due the effect of concentration, because frying is also a process of dehydration. The effect of treatment combination i.e. T_1, T_2, T_3, T_4, and T_5 was significant effect on the protein content (%) of *sev* for finger millet malt at *p≤0.05* can be seen from Table 3(a). Kumar *et al*. (2019) reported that protein content of mushroom flour- rice flour *sev* 15.07%.

Fat

The Fig. 3 shows the fat content for *sev* using finger millet malt and moth bean malt. The fat content was in the range of 10.33 to 11.13 %, it was 10.83, 10.33, 11.13, 10.48, 10.48 for treatments T_1, T_2, T_3, T_4, and T_5 respectively. The highest fat content was observed for treatment T_3 and lowest fat content was observed at treatment T_2. The finger millet malt was increased and moth bean malt decreases from treatment T_1 to T_5 the fat content shows gradually decreases. The effect of treatment combination i.e. T_1, T_2, T_3, T_4, and T_5 was significant effect on the fat content (%) of multigrain mixes for finger millet malt at *p≤0.05* can be seen from Table 3(b). Dhamgunde and Sengupta (2016) reported that fat content of traditional masala *sev* prepared from gram flour 10.6%. Sarangam *et al*. (2017) reported that fat content ready-to-eat extruded snack food product prepared from multigrain mixes i.e., rice flour, wheat flour, Bengal gram and t guava grit flour was 12.78%.

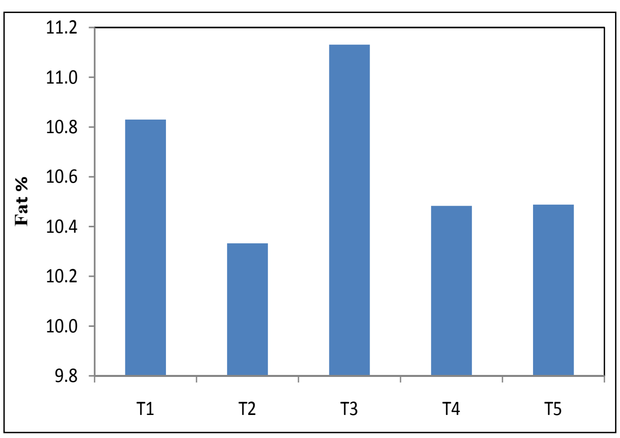

Fig. 3: Effect of various treatments combination (T_1-T_5) of FM malt and MB malt on fat content on *sev*

Moisture content

The Fig. 4 shows the moisture content for *sev* using finger millet malt and moth bean malt. Moisture content was in the range of 1.26 to 1.80%, it was 1.26, 1.39, 1.80, 1.62, 1.46 % for treatments T_1, T_2, T_3, T_4, and T_5 respectively. The highest moisture content was observed for treatment T_3 and lowest moisture content was observed at treatment T_1. As the finger millet malt was increased and moth bean malt decreases from treatment T_1 to T_5 the moisture content shows gradually increases from T_1 to T_2 followed by decreasing trend. The effect of treatment combination i.e. T_1, T_2, T_3, T_4, and T_5 was significant effect on the moisture content (%) of *sev* for finger millet malt at p≤0.05 can be seen from Table 3(c). Moisture content of the multi millet extruded snack formulated with three varieties of millets, soya flour, bengal gram flour, rice and sweet potato flour ranged between 3.2 to 5.4% by Lalitha *et al*. (2018). Sarangam *et al*. (2017) reported that moisture content of ready-to-eat extruded snack food product prepared from multigrain mixes (rice flour, wheat flour, Bengal gram and t guava grit flour) was 1.40%.

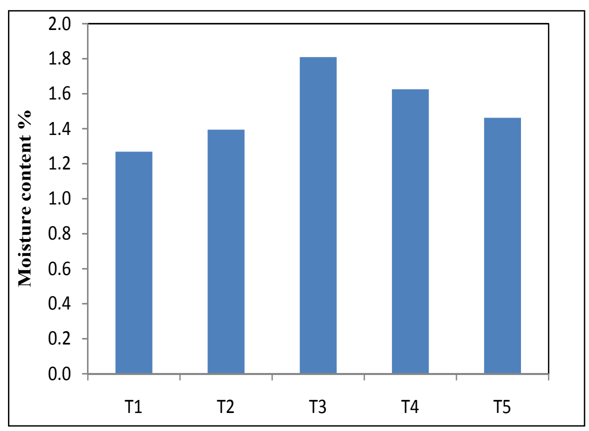

Fig. 4: Effect of various treatments combination (T_1-T_5) of FM malt and MB malt on moisture content of *sev*

Fiber

The Fig. 5 shows the fiber content for *sev* using finger millet malt and moth bean malt. The fiber content was in the range of 1.00 to 1.25 %, it was 1.08, 1.00, 1.25, 1.06, 1.06 % for treatments T_1, T_2, T_3, T_4, and T_5 respectively. The highest fiber content was observed for treatment T_3 and lowest fiber content was observed at treatment T_2. The finger millet malt was increased and moth bean malt decreases from treatment T_1 to T_5 the fiber content gradually decreases. The effect of treatment combination i.e. T_1, T_2, T_3, T_4, and T_5 was significant effect on the fiber content (%) of *sev* for finger millet malt at p≤0.05 can be seen from Table 3(d). Pradeep *et al*. (2014) reported that fiber content of ready-to-eat snack was developed by blending the flour from sorghum and pearl millet flour 2.7%. Bindhya *et al*. (2018) reported that fiber content of *sev* prepared from groundnut flour, wheat flour was 1.75%.

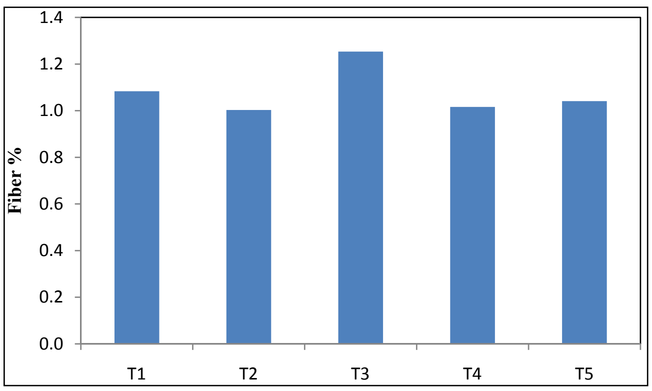

Fig. 5: Effect of various treatments combination (T_1-T_5) of FM malt and MB malt on fiber content of *sev*

Ash

Fig. 6 shows the ash content for *sev* using finger millet malt and moth bean malt. Ash content was in the range of 1.11 to 2.06 %, it was 1.11, 1.17, 2.06, 1.30, 1.37 % for treatments T_1, T_2, T_3, T_4, and T_5 respectively. The highest ash content was observed for treatment T_3 and lowest ash content was observed at treatment T_2. As the finger millet malt was increased and moth bean malt decreases from treatment T_1 to T_5 the ash content shows gradually increasing trend from T_1 to T_3 followed by decreasing trend. The effect of treatment combination i.e. T_1, T_2, T_3, T_4, and T_5 was significant effect on the ash content (%) of *sev* for finger millet malt at *p≤0.05* can be seen from Table 3(e). Veronica *et al*. (2015) reported that ash content in snack prepared from maize, soybean was 2.4%.

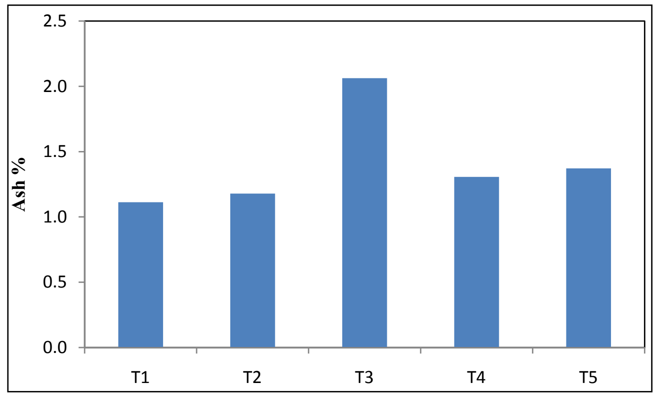

Fig. 6: Effect of various treatments combination (T_1-T_5) of FM malt and MB malt on ash content of *sev*

Carbohydrate

Fig. 7 shows the carbohydrate content for *sev* using finger millet malt and moth bean malt was in the range of 68.33 to 72.00 %, it was 71.28, 72.00, 68.33, 70.39, 71.04% for treatments T_1, T_2, T_3, T_4, and T_5 respectively. The highest carbohydrate content was observed for treatment T_1 and lowest carbohydrate content was observed at treatment T_3. As the finger millet malt was increased and moth bean malt decreases from treatment T_1 to T_5 the carbohydrate content of the *sev* show gradual decreasing trend from T_1-T_3 followed by increasing trend. The effect of treatment combination i.e. T_1, T_2, T_3, T_4, and T_5 was significant effect on the carbohydrate content (%) of *sev* for finger millet malt at *p≤0.05* can be seen from Table 3(f). Veronica *et al*. (2015) reported that ash content in snack prepared from maize, soybean was 71 to 78%.

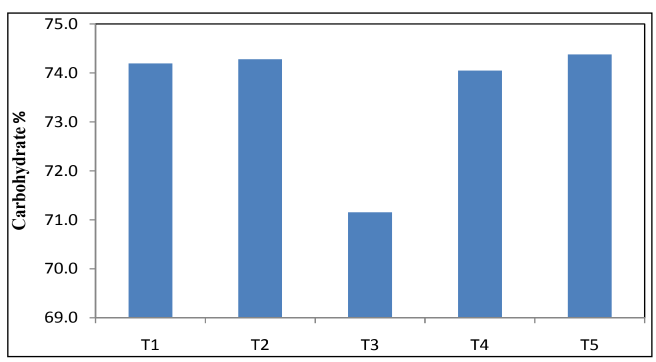

Fig. 7: Effect of various treatments combination (T_1-T_5) of FM malt and MB malt on carbohydrate content of *sev*

Browning Index (B_I)

The Fig. 8 shows the browning index of *sev* using finger millet malt and moth bean malt. The browning index was in the range of 142.25 to 158.00, it was 158.00, 156.58, 142.25, 155.31, 151.88 for treatments T_1, T_2, T_3, T_4, and T_5 respectively. The highest browning index was observed for treatment T_1 and lowest browning index was observed at treatment T_3. As the finger millet malt proportion increased and moth bean malt decreases from treatment T_1 to T_5 the browning index gradually decreases from T_1 to T_3 followed by increasing trend. The effect of treatment combination i.e. T_1, T_2, T_3, T_4, and T_5 was significant effect on the browning index of *sev* from multigrain mixes at $p \leq 0.05$ can be seen from Table 3(g). Nayak *et al*. (2011) reported that decreases browning index of extrudate prepared from purple potato and yellow pea flour mixe from 178.23 to 189.45.

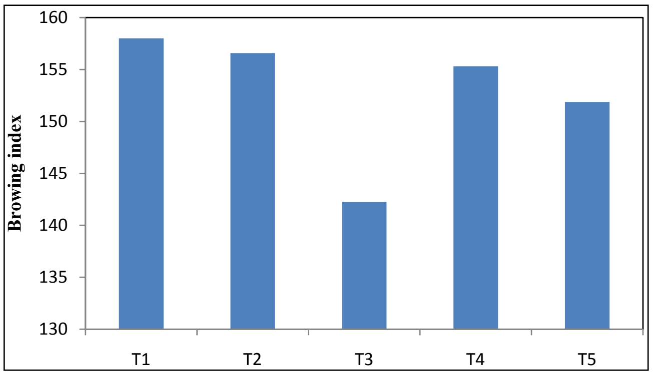

Fig. 8: Effect of various treatments combination (T_1-T_5) of FM malt and MB malt on browning index content of *sev*

Oil uptake ratio

The Fig. 9 shows the oil uptake ratio of *sev* using finger millet malt and moth bean malt. The oil uptake ratio was in the range of 1.87 to 2.42, it was 1.96, 2.31, 1.87, 2.42, 1.77 for treatments T_1, T_2, T_3, T_4, and T_5 respectively. The highest oil uptake ratio was observed for treatment T_2 and lowest oil uptake ratio was observed at treatment T_3. As the finger millet malt was increased and moth bean malt decreases from treatment T_1 to T_5 the oil uptake ratio indicate no specific trend. The higher oil uptake may be due to the increase in degradation products and viscosity of the frying medium due to thermal polymerization and or oxidative deterioration during cooling, which leads to the higher oil absorption by the fried product (Blumenthal, 1991). The effect of treatment combination i.e. T_1, T_2, T_3, T_4, and T_5 was significant effect on the oil uptake ratio of *sev* from multigrain mixes at $p \leq 0.05$ can be seen from Table 3(h). Bajaj and Singhal (2007) reported that oil uptake ratio content of chickpea flour *sev* and legume based *sev* 1.05 and 0.97. Pinthus *et al*. (1992) reported that oil uptake ratio of potato flakes was 0.59.

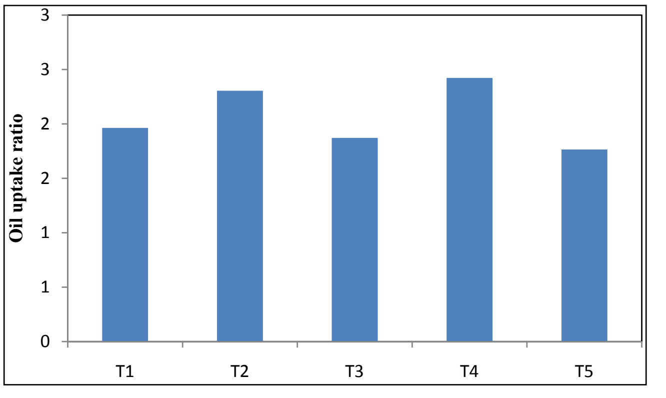

Fig. 9: Effect of various treatments combination (T_1-T_5) of FM malt and MB malt on oil uptake ratio on *sev*

Hardness

The Fig. 10 shows the hardness of *sev* using finger millet malt and moth bean malt. The hardness was in the range of 13.94 to 23.66 (N), it was 22.57, 15.71, 23.66, 15.11, 13.94 for treatments T_1, T_2, T_3, T_4, and T_5 respectively. The highest hardness was observed for treatment T_3 and lowest hardness was observed at treatment T_5. The finger millet malt was increased and moth bean malt decreases from treatment T_1 to T_5 the hardness shows no specific trend. The effect of treatment combination i.e. T_1, T_2, T_3, T_4, and T_5 was significant effect on the hardness (N) of *sev* from multigrain mixes at $p \leq 0.05$ can be seen from Table 3(i). The texture of soya snacks prepared from the blends was affected by the composition of flour blend as shown by the increased values for hardness from 12.86 N to 29.76 N for savoury snack prepared from wheat flour and soya flour (Senthil *et al*. 2002). Sarangam *et al*. (2017) reported that hardness of ready-to-eat extruded snack food product prepared from multigrain mixes (rice flour, wheat flour, Bengal gram and t guava grit flour) was16.10 (N). Chakraborty *et al*. (2009) reported that redy- to-eat extruded snack prepared from barnyard millet and red gram was 24.47 9N).

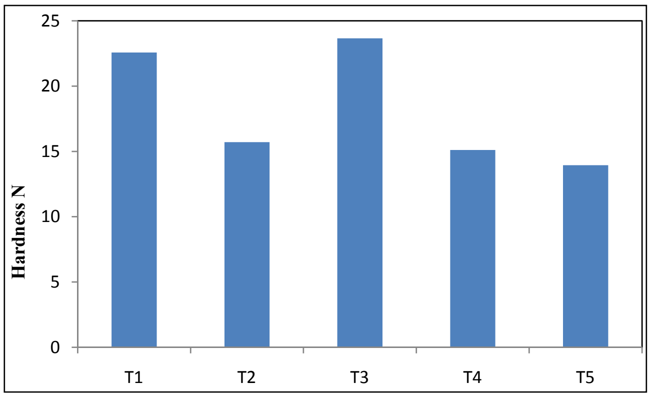

Fig. 10: Effect of various treatments combination (T_1-T_5) of FM malt and MB malt on hardness on *sev*

Calorific value

The Fig. 11 shows the calorific value for *sev* using finger millet malt and moth bean malt. The calorific value was in the range of 446.44 to 451.93 (kcal/100g), it was 451.93, 448.96, 446.44, 451.24, 450.38 for treatments T_1, T_2, T_3, T_4, and T_5 respectively. The highest calorific value was observed for treatment T_1 and lowest calorific value was observed at treatment T_3.

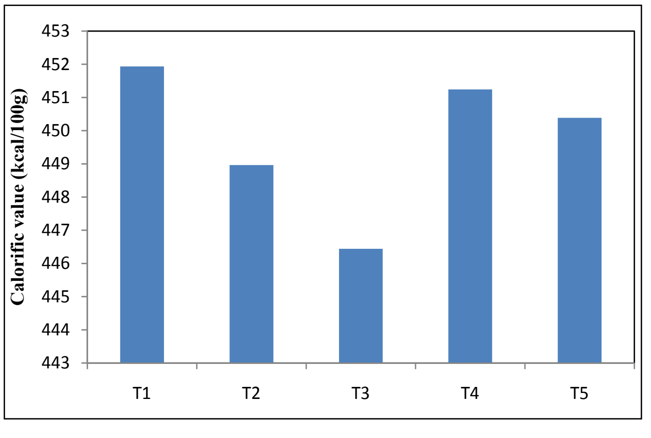

Fig. 11: Effect of various treatments combination (T_1-T_5) of FM malt and MB malt on calorific value of *sev*

The finger millet malt was increased and moth bean malt decreases from treatment T_1 to T_5 the calorific value gradually decreases from T_1 to T_3 followed by increasing trend. The effect of treatment combination i.e. T_1, T_2, T_3, T_4, and T_5 was significant effect on the calorific value (kcal/100g) of sev for finger millet malt at $p \leq 0.05$ can be seen from Table 3(j). Sharma *et al*. (2016) reported that calorific value of multigrain snack prepared from maiz, sorghum, Bengal gram, rice and soya chunk was 377 (kcal/100g).

Sensory Analysis

The data obtained for sensory properties viz. colour, taste, texture, overall acceptability of *sev* as per the nine point hedonic scale were obtained from semi-trained panel for treatment T_1 to treatment T_5 are given in Table 4. The average score of *sev* ranged between 7.2 to 8.4.

Fig. 12 shows the sensory colour score. The sensory colour score was in the range of 7.2±0.2 to 8.3±0.6. Highest colour score was observed at T_3 it was 8.3 and lowest colour score 7.1 was observed at T1. The control sample had 7.2 colour score. Table 4(a) shows ANOVA for the colour of sensory analysis. *Sev* prepared from multigrain mixes (finger millet malt and moth bean malt) shows significant effect at on colour.

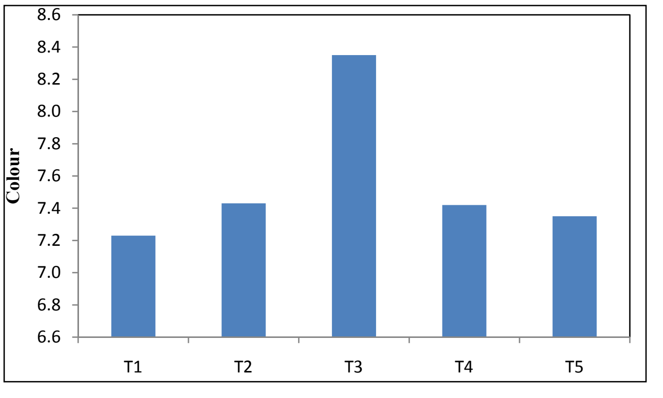

Fig. 12: Sensory analysis of various treatments combination (T_1-T_5) of FM malt and MB malt on colour score of *sev*

Fig. 13 shows the sensory taste score. The sensory taste score was in the range of 7.5±0.2 to 8.8±0.1. Highest taste score was observed at T_3 it was 8.8 and lowest texture score 7.5 was observed at . The control sample had taste scale of 7.1. Table 4(b) shows ANOVA for the taste of sensory analysis. *Sev* prepared from multigrain mixes (finger millet malt and moth bean malt) shows significant effect at on taste.

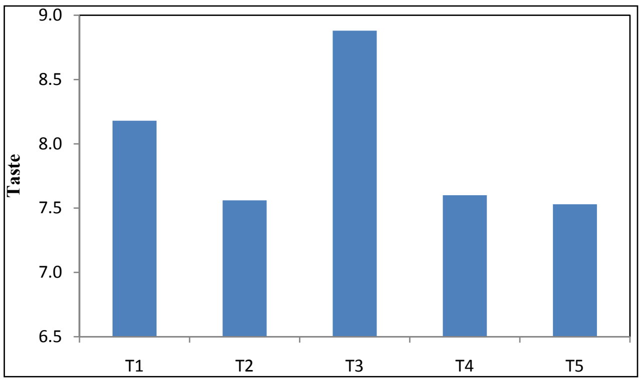

Fig. 13: Sensory analysis of various treatments combination (T_1-T_5) of FM malt and MB malt on taste score of *sev*

Fig. 14 shows the sensory texture score. The sensory texture score was in the range of 7.2±0.2 to **8.5±0.3.** Highest texture score was observed at T_3 it was 8.5 and lowest texture score 7.3 was observed at T_1. The control sample had texture scale of 7.6. Table 4(c) shows ANOVA for the taste of sensory analysis. *Sev* prepared from multigrain mixes (finger millet malt and moth bean malt) shows significant effect at on texture.

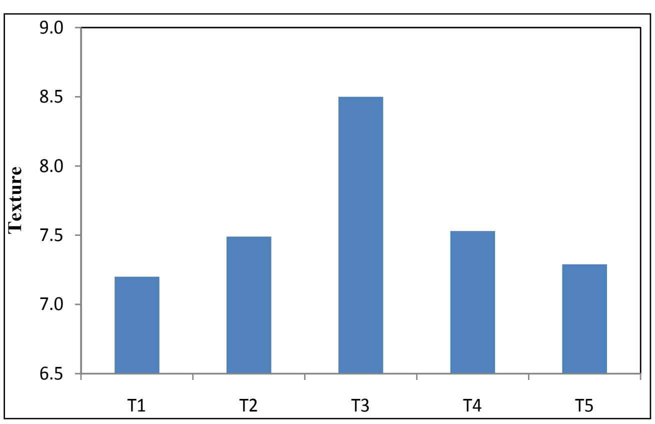

Fig. 14: Sensory analysis of various treatments combination (T_1-T_5) of FM malt and MB malt on texture score of *Sev*

Fig. 15 shows the sensory overall acceptability score. The sensory overall acceptability score was in the range of 7.4±0.2 to 8.5±0.3. Highest overall acceptability score was observed at T_3 it was 8.5 and lowest overall acceptability score 7.4 was observed at T_5. The control sample had overall acceptability scale of 8.5. Table 4(d) shows ANOVA for the overall acceptability of sensory analysis. *Sev* prepared from multigrain mixes (finger millet malt and moth bean malt) shows significant effect at on overall acceptability.

From the sensory score of the *sev* develops from multigrain mixes (finger millet malt 26% and moth bean malt 26%) are significant effect at . on colour, flavour, taste, texture and overall acceptability was observed. It can be concluded that treatment T3 with incorporation of finger millet malt (26%) and moth bean malt (26%) incorporated *sev* has the highest score (colour 8.3±0.6, taste 8.8, texture 8.5, overall acceptability 8.5) resulted the best treatment compared with all other treatments.

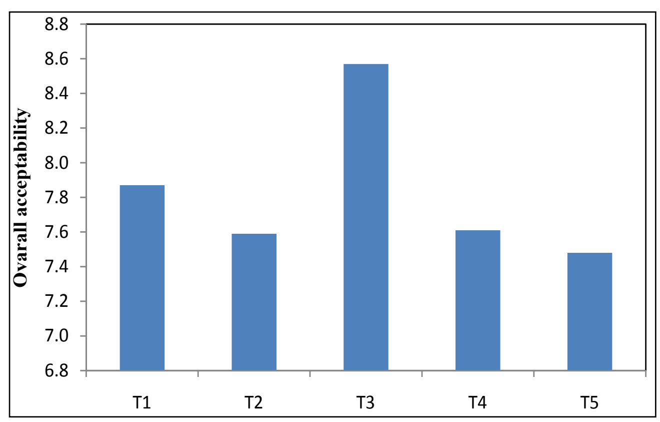

Fig. 15: Sensory analysis of various treatments combination (T_1-T_5) of FM malt and MB malt on overall acceptability score of *sev*

Correlation between the objective and subjective scores

The best sensory score of the product have been obtained from multigrain mixes at finger millet malt 26% and moth bean malt 26% incorporation in *sev*, product achieved that the higher colour 8.3, taste 8.8, and Texture 8.5, moisture content 1.809%, protein

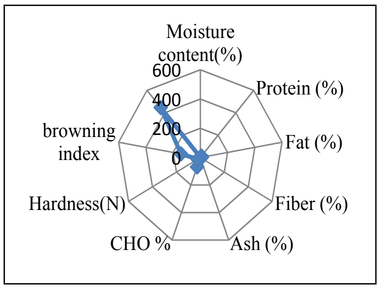

Fig. 16(a): Quality analysis of *sev*

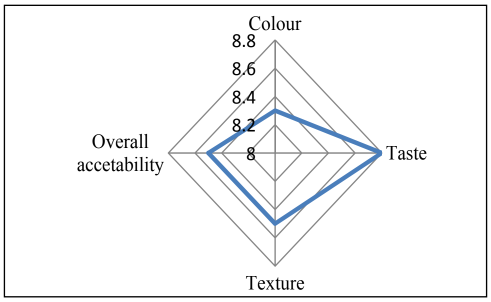

Fig. 16(b): Sensory score of *sev*

Table 3: ANOVA of sensory

Parameter	Sample Code	Colour	Taste	(c)Texture	(d)Overall acceptability
T1	A	7.2±0.2	8.1±0.4	7.2±0.2	7.8±0.4
T2	B	7.4±0.2	7.5±0.2	7.4±0.2	7.5±0.3
T3	C	**8.3±0.6**	**8.8±0.1**	**8.5±0.3**	**8.5±0.3**
T4	D	7.4±0.5	7.6±0.3	7.5±0.4	7.6±0.3
T5	E	7.3±0.2	7.5±0.4	7.2±0.2	7.4±0.2
Control	F	7.2±02	7.1±01	7.6±03	7.3±01
SE± at P≤0.05		1.6	1.4	1.2	1.4
CD at P≤0.05		4.9	4.2	3.7	4.3

12.588 %, fat 11.131%, fibre 1.253%, ash 2.063% and carbohydrate 68.334%, oil uptake ratio 1.87, hardness 23.66 N, browning index 142.25, calorific value 446.44(kcal/100g) which resulted best product among all the treatment.

CONCLUSION

The best quality of *sev* from multigrain mixes can be produced with incorporation of finger millet malt 26% and moth bean malt 26%. *sev* moisture content 1.809%, protein 12.588 %, fat 11.131%, fibre 1.253%, ash 2.063% and carbohydrate 68.334% , oil uptake ratio 1.87%, hardness 23.66 N, browning index 142.25, calorific value 446.44 (kcal/100g) and have heights sensory score higher colour 8.3, taste 8.8, Texture 8.5, overall acceptability 8.5.

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