

1 **STANDARDISATION AND EVALUATION OF FOXTAIL MILLET BASED**
2 **MALT MIX**

3
4 **ABSTRACT:**

5 Foxtail millet has been consumed similar to rice from times immemorial and many
6 products like soups, vermicelli, pasta and malt mixes were done in recent times to increase
7 the nutrient content of various food products. Due to climate changes, millet usage is
8 increasing nowadays as they require less irrigation and can grow in arid and semi-arid region
9 to achieve nutrition security. In this present research, malted foxtail millet was used to
10 increase the carbohydrates, energy, vitamin C, bioavailability of protein and other nutrients.
11 Malt mix were prepared from germinated malt foxtail millet, roasted bengal gram and milk
12 powder in different five formulation. Sensory evaluation was done for selection of best
13 accepted and it was found that germinated foxtail to roasted bengal gram dal in the ratio of
14 2:1 was best accepted. This malt mix along with control germinated foxtail was further
15 analysed for proximate composition and vitamin C content. The selected composite's
16 moisture, ash, fat, protein and crude fibre content were higher for test foxtail millet mix
17 whereas carbohydrates, energy and vitamin C were high for control foxtail millet mix. The
18 lower carbohydrate and energy content as well as higher protein and crude fiber level in the
19 test foxtail millet mix makes it an ideal supplementary food for children between 1 – 3 years
20 of age.

21 **KEY WORDS:** Malt mix, germinated foxtail millet, energy dense supplementary food,
22 preschool children.

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Introduction: Foxtail millet (*Setaria italica* (L.) P. Beauvois) is known as a native of China
26 and is one of the world's oldest cultivated crops. It ranks second in the total world
27 production of millets and continues to have an important place in the world agriculture
28 providing approximately six million tons of food to millions of people, mainly on poor or
29 marginal soils in southern Europe and in temperate, subtropical and tropical Asia. It usually
30 grows in altitudes from sea level to 2000 m, cannot tolerate water logging, is fairly tolerant of
31 drought and can escape some droughts because of early maturity. Due to its quick growth
32 grown as a short-term catch crop and well adapted to a wide range of elevations, soils and

33 temperatures. Its grain is used for human consumption and as feed for poultry and cage birds
34 (Rao *et al.*, 2017).

35 The whole grains and millets are inversely linked to body mass index, waist
36 circumference, total cholesterol, and metabolic syndrome, mortality from cardiovascular
37 diseases, insulin resistance and type 2 diabetes and are nutritionally superior to polished rice
38 (Shobana *et al.*, 2013).

39 Germination or malting result in some biochemical modification like increase in free
40 amino acids and total sugars and decrease in dry weight and starch content, as well as
41 improved protein quality. Processings like germination, soaking, debraning and dry heating
42 reduce antinutrients like phytic acid, tannins, and polyphenols that usually interact with
43 proteins to form complexes (Saleh *et al.*, 2013).

44 Traditionally, millets were processed either by malting or fermentation. The malted
45 and fermented flours were extensively used in preparation of weaning foods, instant mixes,
46 beverages and pharmaceutical products (Rao and Krishna, 2001).

47 Germination is an inexpensive and effective method for improving the overall
48 nutritional quality of food grains by enhancing their digestibility and reducing the contents of
49 anti-nutritional factors (Chavan and Kadam, 1989).

50 Germination of millet grains increased the protein, ash, iron, calcium and phosphorus
51 level of malted mixes developed. The use of locally available low-cost ingredients available
52 in developing countries has great potential for producing highly nutritious, acceptable and
53 dense foods. The addition of malt to foods improved their functional and nutritional qualities
54 and can help in eradication of low birth weight (Swathi *et al.*, 2016).

55 Roasting helps in the formation of desired flavour, and the quality and it improves the
56 flavour, brown colour, texture and overall acceptability of the product (Ozdemir and Devres,
57 2000a, Pittia *et al.*, 2001). Development of roasted flavour and aroma depends upon the
58 temperature and time of roasting. Roasting results in lipid damaged due to oxidation reaction
59 but the damage is less due to the presence of antioxidants like tocopherol and polyphenols
60 that play major role for protection against fat deterioration (Chun *et al.*, 2005).

61 Malted health food drink is among best substitute of a complete food. India is the
62 world's largest malt bases drinks market accounts for 22% of the world's retail volume sales.
63 Malted drinks are traditionally consumed as milk substitutes and also available in mixed with
64 water and marketed as nutritious drinks mainly consumed by the old, the young and the sick
65 persons. Malt is germinated cereal grains that have been dried in a process known as malting.

66 The grains are made to germinate by soaking in water, and are then halted from germinating
67 further by drying with hot air (Dave and Paliwa, 2016).

68 Children develop malnutrition at critical period coincide with the introduction of
69 complementary foods, which are nutritionally inadequate in many developing countries
70 (Khanam *et al.*, 2011). The multi-nutrient food mix was prepared from locally available raw
71 material like coarse cereals, millets, soya bean and dairy products as the need of the hour is
72 for nutritionally balanced, energy dense, easily digestible foods with functional benefits and
73 cost effectiveness (Murugkar *et al.*, 2013).

74 **Materials and methods:**

75 **Procurement of raw materials:** New released foxtail millet was obtained from Agricultural
76 College, PJTSAU, Polasa, Jagtial. The other ingredients like roasted bengal gram dal, milk
77 powder and sugar were procured from local market of Hyderabad. The glassware and
78 equipment were from Post Graduate & Research Centre, PJTSAU, Rajendranagar,
79 Hyderabad.

80 Sensory analysis of germinated foxtail malt mix items was carried out by fifteen semi-
81 trained panellists using 9-point hedonic scale and were scored for colour, consistency, taste,
82 after taste, flavour, appearance and overall acceptability (Meilgaard *et al.*, 1999).

83 Proximate analysis was carried to these malt mix as per the procedures followed by
84 standard AOAC methods. Moisture, ash and protein (AOAC, 2005), fat (AOAC, 1997),
85 carbohydrate and energy (AOAC, 1989), crude fibre (AOAC, 1990) and vitamin C
86 (Ranganna, 2003) were used.

87 **Results and discussion:** Malt mix composite of different formulation of germinated,
88 dehulled and roasted malt along with roasted Bengal gram dal and milk powder in different
89 ratio proportion were prepared as given in Table 1 below:

90 Table 1: **Compositions of malt mix**

Malt mix combinations	Foxtail millet flour (g)	Roasted Bengal gram flour (g)	Milk powder (g)
FMM1	95.00	-	5.00
FMM2	-	95.00	5.00
FMM3	47.50	47.50	5.00
FMM4	63.50	31.50	5.00
FMM5	31.50	63.50	5.00

91 FMM1- Malt mix formulation 1

92 FMM2- Malt mix formulation 2

93 FMM3- Malt mix formulation 3

94 FMM4- Malt mix formulation 4

95 FMM5- Malt mix formulation 5

96 **Sensory evaluation of malt mix:** The composite of five malt mixes were prepared as
97 porridges using mixture of 20g each to which 10g sugar and 100ml water were added and
98 cooked for 4 to 5 minutes and the cooked malt mix weight was 85g. They were subjected to
99 sensory evaluation and the results were as given in Figure 1.

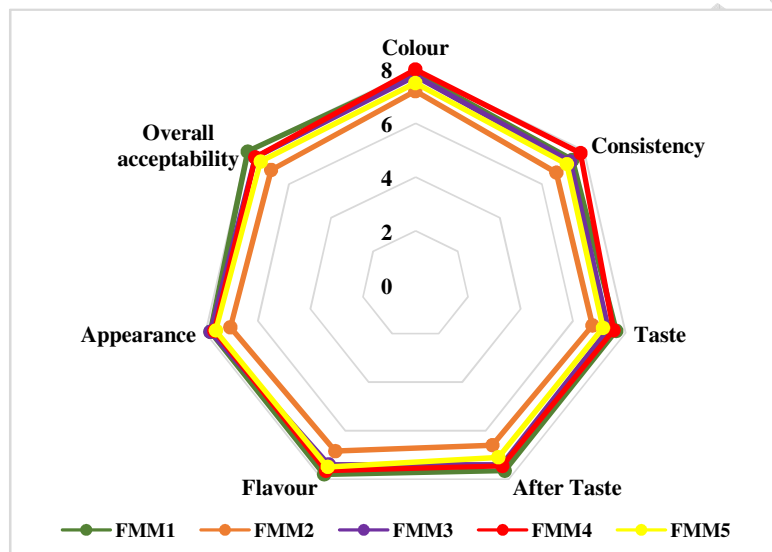


Figure 1: Mean sensory evaluation of malt mix with sugar

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102 The best score for colour malt mix was given to FMM4 with 8.00 ± 0.21 followed by
103 FMM1 7.85 ± 0.25 . The best consistency was for FMM4 with 7.85 ± 0.25 followed by FMM1
104 with 7.45 ± 0.27 . Taste which score highest was FMM1 7.65 ± 0.29 and next was FMM4
105 7.55 ± 0.23 . The product as malted foxtail was leaving an aftertaste. The best scores for
106 aftertaste were FMM1 followed by FMM4 with 7.65 ± 0.26 and 7.45 ± 0.22 respectively. The
107 best flavour acceptance was also for FMM1 followed by FMM4 with 7.80 ± 0.22 and
108 7.65 ± 0.22 respectively. The best acceptance for appearance was for FMM1 and FMM3
109 respectively with score of 7.80 ± 0.20 and 7.80 ± 0.21 for both of them, followed by FMM4
110 with 7.65 ± 0.23 . Overall acceptability was highest for FMM1 with score 7.95 ± 0.22 followed
111 by FMM3 and FMM4 with same score of 7.60 ± 0.21 and 7.60 ± 0.23 . All the sensory
112 parameters were high for FMM1 and FMM4 and hence were selected for malt mix analysis.

113 **Selection of best ready mix:** FMM1 is foxtail millet without addition of Bengal gram dal
 114 and is taken as control whereas FMM4 is foxtail to Bengal gram dal in 2:1 ratio and selected
 115 as test sample.

116 **Analysis of best ready mix:** Porridges prepared with developed ready mix and sensory
 117 evaluation was carried out and the best composition of ready mix was analysed for its
 118 proximate parameters for moisture, ash, protein, fat, crude fibre and vitamin C. Along with
 119 these analyses, carbohydrate content and energy were calculated and all of them were
 120 tabulated in Table 2 below.

121 **Table 2: Nutritive value for selected ready to cook malt mix**

Sample	Moisture (%)	Ash (%)	Fat (%)	Protein (%)	Crude fibre (%)	Carbohydrates (%)	Energy (Kcal/100g)	Vitamin C (mg/100g)
CFMM	6.66±0.16	2.47±0.00	2.50±0.00	10.36±0.06	0.39±0.00	76.40±1.10	396.60±4.50	5.75±0.19
TFMM	7.83±0.16	2.65±0.15	3.95±0.29	12.58±0.14	0.63±0.03	72.34±0.20	375.30±2.70	4.40±0.19
Mean	7.25	2.56	3.22	11.47	0.51	74.37	372.40	5.07
SE of Mean	0.28	0.08	0.34	0.50	0.05	1.03	2.66	0.32
CD	0.71	0.67	1.26	0.33	0.14	4.90	29.75	1.67
CV%	2.81	7.48	11.12	0.83	7.88	1.87	2.27	9.40

122 **Note:** Values are expressed as mean ± standard deviation of three determinations.

123 Means within the same column followed by a common letter do not significantly
 124 differ at $p \leq 0.05$

125 CFMM- Control foxtail malt mix

126 TFMM- Test foxtail malt mix

127 The moisture, ash, fat, protein, crude fibre and carbohydrate content of CFMM
 128 was 6.66±0.16, 2.47±0.00, 2.50±0.00, 10.36±0.06, 0.39±0.00 and 76.40±1.10 % respectively
 129 and that of TFMM was 7.83±0.16, 2.65±0.15, 3.95±0.29, 12.58±0.14, 0.63±0.03 and
 130 72.34±0.20 % respectively. The energy content of CFMM and TFMM were calculated to be
 131 396.60±4.50 and 375.30±2.70 KCal / 100g whereas vitamin C content was 5.75±0.19 and
 132 4.40±0.19 mg/100g respectively. The lowered vitamin C content in the test sample was due
 133 to reduced amount of germinated foxtail millet in comparison with control.

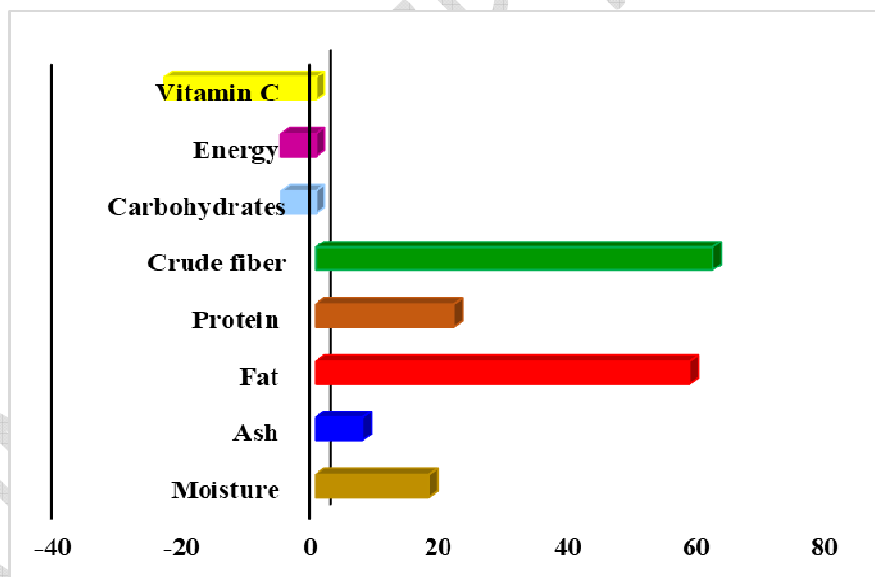
134 Tripathi *et al.*, (2015) also reported protein, crude fibre and ash content of
 135 10.65±0.12, 0.4±0.15 and 1.31±0.17 % respectively of malted finger millet. Laxmi *et al.*
 136 (2015) showed that malt mix of foxtail millet, wheat and chickpea prepared by steeping for
 137 24 hours and germinated for 48 hours in proportions of 40:30:30 were rich in protein and
 138 carbohydrates. The maximum carbohydrates in foxtail millet flour was 58.64% and protein
 139 was 11.16%. These results were more or less similar to result reported in table 3.

Table 3: Nutritive value for selected ready to cook malt mix for serve size

Sample	Moisture (g)	Ash (g)	Fat (g)	Protein (g)	Crude fibre (g)	Carbohydrates (g)	Energy (Kcal)	Vitamin C (mg)
CFMM	5.66	2.09	2.12	8.80	0.33	64.94	337.11	4.88
TFMM	6.65	2.25	3.35	10.69	0.53	61.48	319.00	3.74
Mean	6.15	2.17	2.73	9.74	0.43	63.21	328.05	4.31

141 * Values were calculated and expressed for 85g of cooked CFMM and TFMM.

142 The malt mix was developed for pre-school children of age group 1-3 years and RDA
 143 as per ICMR, (2010) showed the energy requirement as 1060 Kcal/day, protein is 16.7 g/day,
 144 fat is 27 g/day and vitamin C is 40 mg/day. The control of 85g contained fat 2.12 g, protein
 145 8.80 g, crude fibre 0.33g, carbohydrate 64.94g, energy 337.11 Kcal and vitamin C of 4.88
 146 mg/day whereas the test sample contained fat 3.35g, protein 10.69g, crude fibre 0.53g, energy
 147 319.00 Kcal and vitamin C of 3.74 mg/day. Fat, protein and crude fibre were higher for test
 148 sample than control while carbohydrates, energy and vitamin C were higher for control. The
 149 fat, protein, energy and vitamin C content of control was meeting about 7.85, 52.69, 31.80
 150 and 12.20 % respectively of the RDA requirement of pre-school children of age group 1-3
 151 years whereas test sample was meeting 12.40, 64.01, 30.09 and 9.39 % respectively.



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 153 Figure 2: Percentage change in proximate composition of malt mix

154 The difference percentage change between two malt mix CFMM and TFMM for
 155 moisture, ash, fat, protein, crude fibre, carbohydrate, energy and vitamin C was found to be
 156 17.57, 7.29, 58, 21.43, 61.54, 5.31, 5.37 and 23.47 % respectively as shown in figure 2. There
 157 was an increase in the moisture, ash, fat, protein, crude fibre and carbohydrate content for
 158 TFMM whereas energy, and vitamin C decreased. Research studies showed that the fat level
 159 decreases during germination due to increased activity of the lipolytic enzyme during

160 germination (Raham and Aal, 1986). The fat content was found to be reduced on malting and
161 twice as much reduction in energy content (Laxmi *et al.*, 2015). There can be a decrease in
162 carbohydrate level due to germination and fermentation because of increased α -amylase
163 activity (Lasekan, 1996).

164 The Bengal gram dal composition of moisture, protein, fat, crude fibre and
165 carbohydrates were 10.90, 24.0, 1.40, 0.90, 59.60% and energy was 347 Kcal/100g
166 respectively. Legumes are known to reduce the risk of cardiovascular disease, few types of
167 cancers of colon, breast and prostate along with helping in managing body weight due to its
168 satiety value (Kamboj and Nanda, 2017). Hence, inclusion of Bengal gram dhal can improve
169 the nutrient content of this malt mix.

170 **Conclusion:** Among the five malt mix composite prepared, FMM1 and FMM4 had the best
171 sensory scores for colour, consistency, taste, after taste, flavour, appearance and overall
172 acceptability. Proximate analysis was carried out for selected composite and moisture, ash,
173 fat, protein and crude fibre content were high for TFMM whereas carbohydrates, energy and
174 Vitamin C were high for CFMM. So, the incorporation of roasted Bengal gram with
175 germinated foxtail millet were more beneficial than germinated foxtail millet alone on
176 nutritious basis in preparation of malt mixes.

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