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Optimisation of Indian flatbread from herbal enriched wheat based composite flour and its nutrient evaluation

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Abstract
Composite flour is a mixture of flours from cereals, pulses, oilseeds and tubers with or without addition of wheat flour. Medicinal herbs own many health benefits because of its, therapeutic or curative aids. Incorporation of herbs in food products helps to manage many diseases. Wheat based composite flour (WBCF) had been developed by incorporation of black rice, black soya bean, barnyard millet and pumpkin seeds. The present research investigation proceeded by standardizing the composite flour mix by using wheat and other ingredients in the ratio of 70:30, 60:40, 50:50 and 40:60. The developed mixes were subjected to functional properties and sensory evaluation to select the best combination. Best accepted combination of WBCF nutritive value was calculated. Addition of 50 per cent wheat and 50 per cent in combination of other ingredients had better functional properties and sensory scores compared to other treatments. Wheat based composite mix had significantly higher protein and carbohydrate compared to control. Considering the literature studies herbs which are rich in antioxidant activity *viz.*, Indian Tinospora, Indian borage, sessile joy weed, dried ginger, turmeric, and clove had been selected to develop herbal mix. Herbal mix was standardized by considering the sensory evaluation scores of kashaya. Herbal mix treatment 3 (HMT3) had good sensory scores and antioxidant activity compared to other treatments. Further best accepted composite flour was used for the preparation of herbal enriched composite flour by incorporating the developed herbal mix at different composition. Best accepted mix was identified by preparing flatbread and subjected to sensory evaluation. Wheat based herbal enriched mix treatment 3 (HWCF3) had better sensory scores compared to other treatment. It can be concluded that present investigation showed addition of pulses, millet, oilseed and different herbs in the preparation of flour mix helped to improve the nutritional status and to manage macronutrient deficiency in the population.

Keywords: composite flour, herbal mix, flatbread, sensory scores

Introduction

Composite flour (CF) is a mixture of different flours from cereal, legume or root crops with or without addition of wheat flour which helps to satisfy specific functional characteristics and nutrient composition (Bolarinwa *et al.*, 2013). CF provides essential amino acid balance, dietary fibre, antioxidants and high mineral content as compared to wheat flour, which may help to overcome the problem of protein energy malnutrition and other diseases (Teradal, 2013) [31]. The use of composite flour based on wheat and other cereals including minor millets in traditional and bakery products is becoming popular because of the economic and nutritional advantages of composite flour (Bolarinwa *et al.*, 2013).

Herbs are plants with savory or aromatic properties that are used for flavoring, garnishing food, medicinal purposes and for fragrances. The use of medicinal plants has attained an important role in health system all over the world. This involves use of medicinal plants not only for the treatment of disease but also as a potential material for maintaining good health (Yadav *et al.*, 2020) [32]. Herbs are beneficial for human health because as it contains significant amount of micronutrients, vitamins, antioxidants, photochemical and fiber content that may help protect against degenerative diseases and micronutrient malnutrition (Gupta *et al.*, 2012) [15].

Flat bread known as *chapati*, which can be leavened or not, is popular throughout the Indian subcontinent and neighboring Middle Eastern regions. It is typically made from whole wheat flour, though occasionally yeast and fat are added to the recipe to enhance the dough's handling, mixing, and textural qualities (Gocmen, *et al.*, 2009) [12]. The product is made by combining flour, water, and other ingredients to make dough, which is then sheeted and quickly baked (Gujral, *et al.*, 2004) [13]. They are typically produced in homes and are a cheap source of protein and calories.

They have a creamish brown colour (Dhingra and jood, 2001) [9].

The COVID 19 outbreak has left the entire human race suffering on a global scale. Improving the body's defences is crucial to keeping it in top health. Prevention is always preferable to treatment, as we all know. Although there is currently no treatment for COVID-19, it will be beneficial to take preventive measures by eating a variety of foods that are high in minerals, vitamins, proteins, and antioxidants. Though underutilized cereals and pulses are rich in protein, fat, dietary fiber, minerals, vitamins, and essential amino acids, very limited studies are available in the preparation of RTE and RTC food products. Hence, considering the present situation study "optimization of Indian flatbread from herbal enriched wheat based composite flour and its nutrient evaluation" was conducted with the following objectives.

1. Standardization of composite flour and herbal mix and its evaluation
2. Analysis of nutrient composition of herbal enriched composite flour mix
3. Development of Indian flat bread from herbal enriched composite flour mix

Materials and Method

Development of wheat based composite flour mix: For the preparation of wheat based composite flour mix, wheat was substituted with other ingredients such as black rice, black soya bean, barnyard millet and pumpkin seeds. Each ingredient were cleaned, dried and powdered separately to prepare composite flour mix. The powdered ingredients were weighed at different level and used for the preparation of wheat based composite flour mix. Composite flour was developed by incorporating other ingredients at different levels (Table 1) by substituting wheat flour at different ratios (70:30, 60:40, 50:50 and 40:60).Developed Composite flour mixes were analyzed for the functional properties and gruel was prepared and subjected for sensory evaluation. Nutritive value of best accepted flour mix was calculated and used for the enrichment with herbal mix

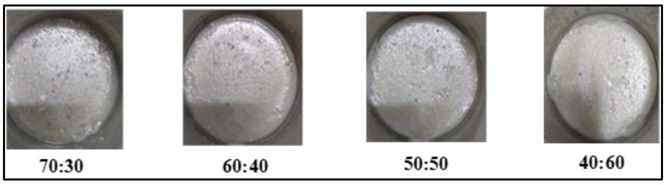


Fig 1: Finger millet based composite flour gruel

Functional properties of composite flour

Functional properties such as water absorption capacity, oil absorption capacity, swelling power, swelling capacity was analyzed to finger millet based and wheat based composite flour to select the best combination.

Water absorption capacity (WAC)

A suspension of 1.0 g of sample in 10 ml distilled water was agitated 4 times allowing 10 min. resting periods between each mixing and centrifuged at 3250 rpm for 25 min. The supernatant was decanted and tubes were air-dried and then weighed (Sindhu and Khatkar, 2016) [29].

WAC (ml/g)=Volume of water/weight of sample absorbed

Oil absorption capacity (OAC)

The 3 ml refined groundnut oil was added to 0.5 g of sample and stirred for 1 minute. After 30 min. at room temperature, the tubes were centrifuged at 3200 rpm for 25 minutes. The volume of unabsorbed oil was determined (Sindhu and Khatkar, 2016) [29].

OAC (ml/g) = Volume of fat/weight of sample

Swelling capacity

The swelling capacity was determined by the method described by Potter and Hotchkiss (1966). 100 ml graduated cylinder was filled with the sample to 10 ml mark. The distilled water was added to give a total volume of 50 ml. The top of the graduated cylinder was tightly covered and mixed by inverting the cylinder. The suspension was inverted again after 2 min and left to stand for a further 8 min and the volume occupied by the sample was taken after the 8th min.

Foam capacity

The foam capacity (FC) were determined as described by Hasmadi *et al.*, 2020 with slight modification. One gram of flour sample was added to 50 mL distilled water at 30 ± 2°C in a graduated cylinder. The suspension was mixed and shaken for 5 min to foam. The volume of foam at 30 sec after whipping was expressed as foam capacity using the formula

$$\text{Foaming capacity (\%)} = \frac{\text{Volume of foam AW- Volume of foam BW}}{\text{Volume of foam BW}} \times 100$$

Where, AW = after whipping, BW = before whipping.

The volume of foam was recorded one hour after whipping to determine foam stability as per percent of initial foam volume.

Flour dispersibility

Dispersibility is an index that measures how well flour blends can be rehydrated with water without formation of lumps. The flour dispersions of 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, and 30% (w/v) prepared in 5 ml distilled water was heated at 90°C for 1 hr in water bath. The contents were cooled under tap water and kept for 2 hr at 10 ± 2 °C (Baranwal and Sankhla, 2019)

Bulk density

The volume of 100 g of the flour was measured in a measuring cylinder (250 ml) after tapping the cylinder on a wooden plank until no visible decrease in volume was noticed, and based on the weight and volume, the apparent (bulk) density was calculated (Jones *et al.*, 2000)

$$\text{Bulk density (g/ml)} = \frac{\text{Seed weight (g)}}{\text{Seed volume (ml)}}$$

Sensory evaluation of developed composite mix gruel

Finger millet and wheat based composite flour was developed by using black rice, black soy bean, barnyard millet and pumpkin seed in different proportion. Gruel was prepared from the developed mix and given for sensory evaluation by a group of 21panel members by using 9 point hedoinic scale to select the best combination. Developed gruel was represented in plate 3. Flow chart for the preparation of gruel was presented in fig. 2

Development of Herbal mix

Different herbs such as Indian Tinospora, Clove, Sissely joyweed, Indian borage, Turmeric, dried ginger were procured from Horticulture department, UAS, GKVK, Bangalore. Herbs were cleaned and dried to remove moisture content. Further the herbs made into fine powder by using mixie and sieved with mesh size (60 µm).

Sensory evaluation of herbal kashaya drink

Herbal kashaya drink was prepared from different treatment of herbal composite mix and given for sensory evaluation by a group of 21 panel members using 9 point hedoinic scale to select the best combination. Flow chart for the preparation of herbal kashaya drink was presented in fig. 3. Prepared herbal mix and kashaya were represented in plate 4.

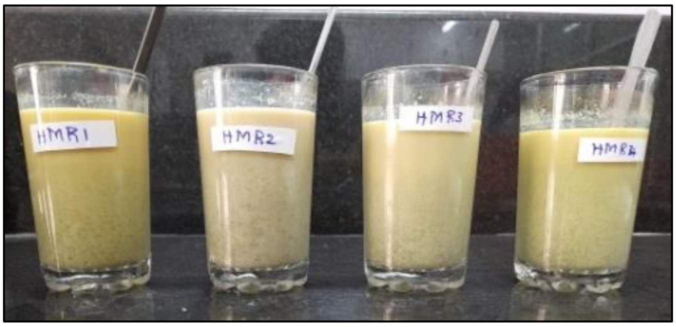


Fig 2: Herbal mix Kashaya drink

Development of herbal enriched wheat based composite flour mix

Best combination of composite flour mix and herbal mix was used for the development of herbal enriched wheat based composite flour mix. Standardized composite flour mix was substituted with herbs in the ratio of 85:15, 90:10, 95:5 had been added to formulate herbal enriched composite mix. The developed mixes were used for the preparation of *chapathi* and subjected for sensory evaluation to know the acceptability.

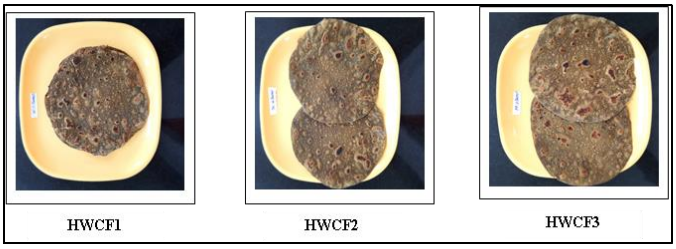


Fig 3: Herbal enriched wheat based *chapathi*

Nutrient composition of herbal enriched wheat based composite flour mix

Proximate principles (PC): PC *viz,* moisture, fat, crude protein, crude fiber and ash by standard methods (AOAC, 2005). Difference method was used to calculate carbohydrate and energy value by computation method.

Statistical analysis

The SPSS version 16 software programme was used to estimate the mean, standard deviation, standard error mean, 'S.E diff'., 'CD' and 'F' value. One – way ANOVA was employed to know the difference between the products (Fisher and Yuest, 1963) [11]. The data thus obtained from nutrient contents were statistically analyzed by applying 't' test. The critical difference between the products was tested at 5 per cent significance.

Result and Discussion

Table 2 shows the functional characteristics of the composite flour mix made from wheat. Water absorption capacity (WAC) provides a measure of the amount of water available for gelatinization and is crucial for product consistency, bulking and baking applications (Edema *et al.*, 2005) [10]. Wheat capacity to absorb water was found to be much lower (1.23) V/S wheat-based composite flour mix. The lesser number of hydrophilic components in wheat flour may be the cause of the lower WAC of wheat flour (Akubor and Badifu, 2004) [5]. Less availability of polar amino acids in flours results in a lower capacity to absorb water. This impact may be caused by the loose interaction of amylose and amylopectin in the native granules of starch and by weaker associative forces that preserve the granules' structure (Mc Watters *et al.*, 2003; Nasr and Abufoul, 2004 and Falola *et al.*, 2011) [23]. Proteins and carbohydrates are the main chemical components of flours that increase their ability to absorb water because they contain hydrophilic components like polar or charged side chains (Lawal and Adebowale, 2004) [19]. Similar to the current study, Poongodi and Jemima (2009) [26] also noted WAC values of composite flour (wheat, kodo, barnyard millet and defatted soy flour) ranging from 1.39 to 1.48 g/g.

As shown in Table 2, which provides information on the oil absorption capacity of flour, wheat-based composite flour had the highest OAC - 1.92 g/g. The oil absorption capacity of the composite mix made from wheat was much higher. This implied that wheat-based composite flour may have more hydrophobic proteins; these proteins exhibit superior lipid binding (Lawal and Adebowale, 2004) [19]. According to Jitngarmkusol *et al.* (2008) [16] protein which is made up of both hydrophilic and hydrophobic components is the primary chemical factor influencing oil absorption ability. Additionally, the current investigation supported the findings of Adetuyi *et al.* (2009) [2] study that malted composite flour had a higher potential to absorb oil than wheat flour. The existence of more nonpolar side chains, which may bond the oil hydrocarbon side chains in meals and flours, is one explanation for the potential rise in OAC of flours. The structural interactions of meals may benefit from flours with high OAC, especially for improving palatability, extending shelf life and retaining flavour, especially in meat or bread where fat absorption is desired (Suresh *et al*. 2015) [30].

In some high-quality formulations like bread, swelling capacities are considered a quality requirement. It is a sign that molecules within starch granules have non-covalent bonds with one another as well as a result of the ratio between -amylose and amylopectin (Osungbaro *et al.* 2010) [25]. According to Schoch (1964) [27], the kind and species of starch in the flour samples affects the swelling level and the quantity of soluble components. The swelling power and per cent solubility of flours are shown in Table 2. It may be determined that wheat-based composite flour had a substantially larger swelling power than wheat flour (7.16%; p>0.01). Because the blend's overall carbohydrate content may have increased due to the addition of more carbohydrates from black soy beans, black rice, and barnyard millet, the rise in swelling capacity may be explained by this. Congruent results were found by Adetuyi *et al.* (2009) [2]. They reported that swelling power was increased in maize soy blend in comparison to wheat flour.

One of the functional qualities that is typically tested while developing and evaluating a novel flour is flour solubility. It is necessary to identify a novel food's solubility or the solubility of its constituent parts as an useful attribute. A food's high solubility can indicate its great digestion, which may point to its outstanding suitability as food and infant formula. The opposite of a food's capacity to dissolve in a liquid, gaseous, or solid solvent is said to be insoluble. Composite flour made from wheat has a higher per cent solubility (15.92). The solubility of wheat-based composite flour enhanced with the addition of black rice and black soy bean. Nutra flour's solubility is consistent with the results of the current research (Suresh *et al*., 2015) [30].

Dispersability is a trait that describes how easily flour separates from water molecules and demonstrates how this interacts hydrophobically. A mixture's capacity to disperse in water suggests that it can be reconstituted. The better the property of reconstitution, the higher the dispersability. Teradal *et al*. showed that higher protein dispersibility improves the emulsifying and foaming capabilities of proteins during the production of bread, macaroni, and cookies. The dispersibility of composite flour made from wheat was greater. Kulkarni *et al*. (1991) [18] obtained same results and stated that the per cent dispersibility of the weaning meal formulations (Sorghum malt, Green gram malt and sesame flour) ranged from 63 to 79.

In the present research study, mean values for foaming capacity and stability of wheat based composite flour are given in Table 2. It was found that both foaming capacity across various samples varied considerably (p>0.01). The foaming capacity of wheat flour was 21.33%. When 50% of the composite mix and 50% of the wheat flour were used, the foaming capability of the wheat-based composite flour was 33.66%. In comparison to composite flour made with wheat, wheat flour has the highest foaming capability and stability. Similar findings were made in the study by Poongodi and Jemima (2009) [26], which showed that the amount of millet (kodo and barnyard millet) in the composite flour (wheat + millet blend + defatted soy flour) reduced significantly (p 0.01) with an increase in millet content.

The bulk density of composite flour found more when various flours were added to wheat flour. It is obvious that a reduction in the percentage of wheat flour results in an increase in the bulk density of composite flours. The flour's high bulk density suggests that it can be used to prepare food. Low bulk density, however, would be advantageous when creating complementing foods (Aremu *et al*., 2007) [4]. Because it helps to lower paste thickness, an important feature in food preparation, the current study reveals that wheat-based composite flour with the highest bulk density is suitable for use as a thickener in food items and for use in food preparation. The bulk density of composite flours dramatically rose when the percentage of black soy bean, black rice, and barnyard millet in wheat flour increased. The same results were reported by (Gull *et al*., 2015) [14].

Sensory score of wheat based composite flour mix gruel

Sensory score of wheat based composite flour mix gruel was presented in the fig. 4.As the percentage of blacksoyabean and black rice increased in the composite mix sensory scores were decreased. 50 per cent of wheat, 50 per cent of the combination of barnyard millet, black rice, black soy bean and pumpkin seeds scored higher and accepted by the panel members. Wheat based composite flour treatment 3 (WCT3) scored higher scores with respect to all the sensory parameters such as appearance, color, flavor, taste, texture and overall acceptability. Wheat based composite flour mix scored higher overall acceptability scores 7.95. Among the variation in composite flour significant difference was found in flavor and taste (bitterness and astringency) scores in wheat based composite flour because the addition of Blacksoyabean which is having higher saponins and isoflavones. Addition of black rice which is having nutty and mildly sweet flavour which masks the bitterness of soy bean. Pumpkin seeds have a high oil content, When exposed to air and heat, this oil can begin to go rancid in a process known as rancidification, which changes the taste of the seed. Panel members accept the WCT3 among the different variations.

Sensory evaluation of herbal Kashaya drink

Fig. 5 depicts the sensory scores of herbal Kashaya. There was a statistically significant difference with respect to the sensory parameters such as appearance, flavor and taste between the treatments. The scores for appearance and color was found to be high in HMT1 followed by HMT2. Flavor, taste and Overall acceptability scores found be highest in HMT3 with score of 7.71, 7.52 and 7.51 respectively and least score was observed in HMT4 (7.35). Significant difference in flavor and taste was found in the treatments because the amruthaballi bitterness due to the presence of Lactones and diterpenoids. Also due to clove pungent warm spice with an intense flavor due to the presence of compound Eugenol.

Sensory scores of herbal enriched wheat based composite flour mix *chapathi*

Table 3 presents the sensory scores of herbal enriched wheat based composite flour mix *chapathi*. The one way analysis of variance indicated that all these sensory attributes were significantly (p<0.05) different and thus the *chapathis* showed varied degree of acceptability in terms of appearance, flavor, taste, texture and overall acceptability. Sensory score of herbal enriched wheat based composite flour *chapathi* found to be higher in treatment HWCF3 with scores of appearance (7.71), color (7.76), flavor (7.61), taste (7.66) and texture (7.80). Overall acceptability scores also found to be higher (7.80) in HWCF3. This may be due to the lesser addition of herbal mix to composite flour. Hence the panel members accepted the HWCF3 treatment. Sensory scores of herbal enriched wheat based composite flour *chapathi* scored (7.80). However, McWatters and Holmes (1979) [21] have suggested application of household thermal treatments such as steaming on legumes to improve the overall aroma and taste of meals. On the other hand, decrease in mean scores for texture can be attributed to the fact that the herbal enriched composite *chapatis* become harder when more black rice and black soy bean flour is incorporated into the formulations. Our observations were in agreement with those reported by Ameh *et al*. (2013) [11] in which the overall acceptance of wheat-rice bran composite breads decreased as more rice bran was incorporated into the bread.

Nutrient composition of herbal enriched wheat based composite flour mix: Proximate composition of herbal enriched wheat based composite flour mix represented in the table 4. Herbal enriched wheat based composite flour had higher moisture, protein, fat, crude fiber and ash content 12.79, 16.45, 7.66, 3.36,3.57 g/100 g respectively compared to wheat. The carbohydrate content decreases with the decrease in the percentage of wheat flour. Similar studies were done by (Nandini and Salimath, 2001) [22]. Carbohydrate content of the developed composite flour was found to be in the range of 38.15 g/100g to 48.75 g/100g.

The high protein content observed in herbal enriched wheat based composite flour indicated that wheat contained significant amounts of protein than finger millet. This higher protein content might be due to higher protein digestibility in the sample as well as the presence of total essential amino acids in wheat. Addition of black soy bean to finger millet and wheat herbal enriched composite flour increases the protein percentage in herbal enriched composite mix. Similar studies were reported by Dogore *et al*. (2013) [8] who stated that the composite flour was prepared by Yam, Soy bean and Cassava in (60, 30,10 per cent) and found crude protein content of the range between 15.21 per cent to13.83 per cent. Quantity and quality of protein in the flour are critical aspects that are used to achieve the desired texture of instant noodles and they vary among the type and quality of the final products to be made. Protein content of flour generally ranges from 7 percent to 9.5 percent for high quality instant noodles and about 11.5 per cent to 12 per cent for cup instant noodles. The high amount of fat in herbal enriched finger millet and wheat based composite flour is due to the addition of blacksoyabean and pumkin seeds. Similar results were observed by Bolarinwa *et al*. (2015) [7]. Results of the present study are supported by the results of (Amir *et al*., 2014) [3] also reported that sorghum soy composite flour contain (3.6 per cent) of fat. The fat content (2.08-3.92g/100g) of the composite flour obtained in this study is in line with the fat content (4.-6.2 per cent) of rice and soy flour blends.

The ash content of the composite flours was less than 2% which is acceptable according to FSSAI standards. A similar increase in ash content in wheat-cassava composite flour was also reported by Masamba and Jinazali, 2014 [20]. The increase observed in the crude fibre content of herbal enriched finger millet and wheat based composite flour might be as a result of high crude fibre content in finger millet and blacksoyabean might have contributed to higher crude fibre content. Crude fibres are known to be indigestible to the digestive system of man, which are significant to colon and heart because they have the ability to delay the release of gastric juice, modulate inflammations of the intestines and also improve the bulk of food (Shittu *et al*., 2007) [28]. The fiber content 4.25-1.8 g/100 g obtained in this study is in line with the fiber content (3.3-5.7%) of wheat and soy composite flour reported by Ndife *et al*. (2014). However, lower fibre content (1.2-1.72%) was reported for rice and soy bean flour blends.

The ash content is a measure of total amount of minerals available present within food, whereas the mineral content is a measure of the amount of specific inorganic compounds such as calcium, potassium, magnesium, iron, zinc and other minerals. Energy values of herbal enriched wheat based composite flour exhibited higher moisture (12.79), protein (16.45), fat (7.66), crude fiber (3.36) and ash (3.57) compared to wheat. Energy value of herbal enriched wheat based composite flour found to be higher 360 Kcal compared to wheat. Proximate composition found to be significantly higher in herbal enriched wheat based composite flour. These values meet the FSSAI standards for flours or fortified atta of not more than 12-14 per cent moisture in flour blends.

Nutritional characteristics of grain based composite mixes developed by Teradal, (2013) [31] also showed 15.2 g moisture, 18.3g protein, 5.2 g fat, 5.9 g crude fibre, 48.3 g carbohydrate, 313 Kcal energy and 6.8 g ash per 100 g of the sample. The results on proximate composition from the study conducted by Twinomuhwezi *et al*. (2020) showed that the moisture content ranged from 5.99 to 9.82 per cent. The ash content ranged from 1.01 to 2.83 per cent, the fat content ranged between 0.77 to 8.96 per cent followed by the protein content ranged between 6.91 to 18.17 per cent, carbohydrate content ranged between 67.1 to 81.58 per cent; the total energy ranged between 364 Kcal to 414 Kcal and fiber content ranged between 0.99 to 1.12 per cent.

Table 1: Formulation of composite flour mix

Sl. No.	Ingredients	WCT1 (70:30)	WCT2 (60:40)	WCT3 (50:50)	WCT4 (40:60)
1.	Wheat	70	60	50	40
2.	Barnyard millet	15	15	15	15
3.	Black rice	5	10	15	20
4.	Black soy bean	5	10	15	20
5.	Pumpkin seeds	5	5	5	5

WCT1- Wheat based composite flour treatment 1 (70:30)
WCT2- Wheat based composite flour treatment 2 (60:40)
WCT3- Wheat based composite flour treatment 3 (50:50)
WCT4- Wheat based composite flour treatment 4 (40:60)

Table 2: Functional properties of wheat based composite flour mix

Treatments	Water absorption capacity (%)	Oil absorption capacity (%)	Swelling power (%)	Solubility (%)	Dispersibility (%)	Foaming capacity (%)	Bulk density (g/ml)
Control (Wheat)	1.34±0.07	1.53±1.00	7.16±0.01	13.90±0.03[c]	71.83±0.42[a]	41.33±0.02[a]	0.76±0.02[a]
WCT1	1.59±0.05[d]	1.69±1.01[d]	8.84±0.04[a]	14.06±0.05[b]	67.33±0.57[b]	38.16±0.05[b]	0.78±0.01[a]
WCT2	1.83±2.51 [c]	1.75±1.05 [c]	10.01±0.01[b]	14.82±0.05[b]	65.54±0.11[b]	37.46±0.15[b]	0.81±0.01[b]
WCT3	2.01±3.61 [b]	1.87±1.55 [b]	10.98±0.01[c]	15.51±0.05[a]	64.36±0.57[b]	35.18±0.15[c]	0.84±0.01[d]
WCT4	2.36±2.58 [a]	1.92±1.58 [a]	12.16±0.02[d]	15.92±0.01[a]	61.13±1.15[c]	33.66±0.10[c]	0.89±0.01[c]
F value	**	**	**	**	**	**	**
S.Em	28.07	9.57	0.28	0.027	4.43	3.03	0.06
CD@ 5%	91.55	31.21	0.92	0.089	14.47	9.90	0.206

WCT1- Wheat based composite flour treatment 1 (70:30), WCT2- Wheat based composite flour treatment 2 (60:40)
WCT3- Wheat based composite flour treatment 3 (50:50), WCT4- Wheat based composite flour treatment 4 (40:60)
*- Significant at 0.05 per cent Different super scripts within a column indicate significant difference at 0.05 level by DMRT

Table 3: Sensory scores of herbal enriched wheat based composite flour mix *chapathi*

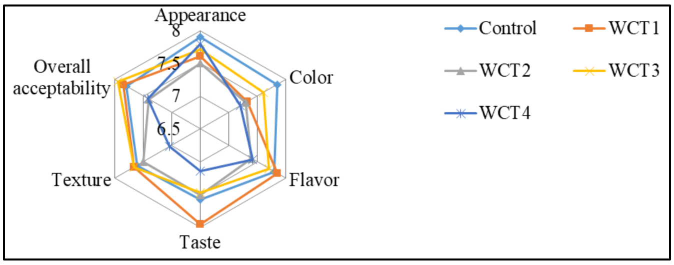
Treatments	Appearance	Color	Flavor	Taste	Texture	Overall acceptability	Ranking
HWCF1	7.14±0.85^{a}	7.14±0.57^{b}	6.80±0.23^{b}	6.90±1.04^{b}	7.09±0.53^{a}	7.00±0.63^{b}	III
HWCF2	7.57±0.81^{a}	7.66±0.48^{a}	7.52±0.81^{a}	7.47±0.79^{a}	7.71±0.46^{a}	7.61±0.66^{a}	II
HWCF3	7.71±1.10^{a}	7.76±0.99^{a}	7.61±1.20^{a}	7.66±1.28^{ab}	7.80±1.07^{b}	7.80±0.98^{a}	I
f-value	NS	*	*	NS	*	*	
S.Em±	0.20	0.15	0.22	0.37	0.52	0.54	
CD@ 5%	0.57	0.44	0.64	1.05	1.47	1.54	

HWCF1- Herbal enriched wheat based composite flour treatment 1 (wheat based composite flour: Herbal mix 85:15)
HWCF2- Herbal enriched wheat based composite flour treatment 2 (wheat based composite flour: Herbal mix 90:10)
HWCF3- Herbal enriched wheat based composite flour treatment 3 (wheat based composite flour: Herbal mix 95:5)
Note: S.Em: Standard Error of mean, C.D: Critical Difference, NS- Non Significant, ** - Significant at 0.01 per cent level, *- Significant at 0.05 per cent Different super scripts within a column indicate significant difference at 0.05 level by DMRT

Table 4: Proximate composition of herbal enriched finger millet based and wheat based composite flour mix

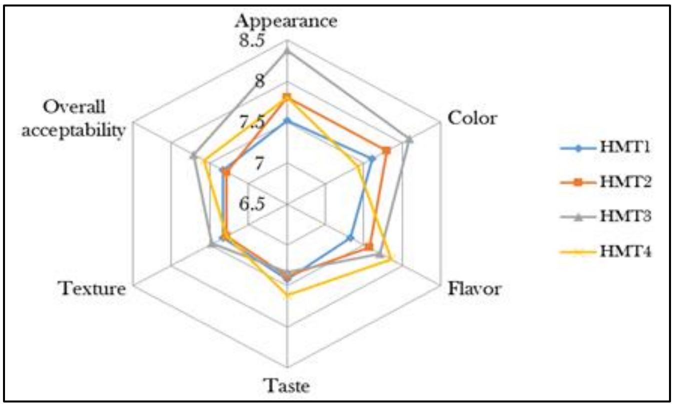
Treatments	Moisture (g/100 g)	Protein (g/100 g)	Fat (g/100 g)	Crude fiber (g/100 g)	Ash (g/100 g)	Carbohydrate (g/100 g)	Energy Kcal
Control (Wheat)	11.29±0.20	10.25±0.15	1.99±0.05	2.54±0.09	1.65±0.20	72.27±0.52	348±1.17
HWCF3	12.79±0.21	16.45±0.19	7.66±0.15	3.36±0.10	3.57±0.30	56.13±0.66	360±1.86
t value	NS	*	*	NS	*	*	*

Control- Wheat,HWCF3- Herbal enriched wheat based composite flour treatment 3 (finger millet based composite flour: Herbal mix 95:5)
Note: *- Significant at 0.05 per cent *Carbohydrates- Difference method *Energy- Computation method



WCT1- Wheat based composite flour treatment 1 (70:30) WCT2- Wheat based composite flour treatment 2 (60:40)
WCT3- Wheat based composite flour treatment 3 (50:50) WCT4- Wheat based composite flour treatment 4 (40:60

Fig 4: Sensory scores of wheat based composite flour mix gruel



HMT1- Herbal mix treatment IT- 1 g CL- 1 g DG- 2 g SJ- 2 g IB- 2 g T- 2 g
HMT2- Herbal mix treatment IT- 0.5 g CL- 1.5 g DG- 2 g SJ- 2 g IB- 2 g T- 2 g
HMT3- Herbal mix treatment IT- 1 g CL- 1 g DG- 2 g SJ- 2 g IB- 2 g T- 2 g
HMT4- Herbal mix treatment IT- 1.5 g CL- 0.5 g DG- 2 g SJ- 2 g IB- 2 g T- 2 g

Fig 5: Sensory evaluation of herbal Kashaya mix

Conclusion

Addition of wheat with other ingredients rich in protein and micronutrients plays an important role in maintaining overall health. Results concluded that 50 per cent of wheat and 50 per cent of other ingredients had better sensory scores compared to other treatments. Best accepted composite flour mix had good nutrient composition compared to control. Addition of five per cent of herbal mix to wheat based composite flour *chapathi* had better sensory scores by panel members. To increase the consumption of macronutrients there is a need for fortification to the staple food because the single cereal food is lacking in protein and fatty acids. Hence, wheat based composite flour enriched with other cereal, millet, oilseed and herbs fortification to the wheat helps to improve nutritional status of the population.

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