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Noodles with Assorted Nutraceuticals: Development, Acceptability, Micronutrient and Total Phenol Content

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ABSTRACT

Noodles are the most affordable designer food. Refined flour is the main ingredient for them. In the present study, noodles were developed to enhance the micronutrient content of noodles which is typically lacking in refined flour-based noodles. Three treatments (T2, T3 and T4) of noodles were optimized at different concentrations of defatted soya flour (DSF) and WF (wheat flour), whereas T1 (100 per cent wheat flour (WF) was treated as control. Three flavours (F1, F2 and F3) with different combinations of tomato, ginger and tangerine peel powder were also standardized. Developed noodles and flavours were evaluated and compared for their acceptability, vitamin and mineral content and total phenol content (TPC). T4 and F2 were had the highest Index of Acceptability (IA). A significant ($p<0.05$) augmentation in vitamin A and E content after DSF incorporation was recorded in T2. Calcium, iron and zinc contents were also increased. TPC of noodles was higher than the control.

Keywords : Flavours, Mineral content, Noodles, Total phenol content (TPC), Vitamin content

IRRESPECTIVE of geographical (rural or urban) settings, noodles have been recurrently consumed both for snacking and replacing major meals among masses from all types of socioeconomic strata's since being a cheaper source of energy as well as its instant cooking quality (Taneya *et al.,* 2014). These are the most affordable and easily accessible food products, consisting of refined wheat flour as its main ingredient. Wheat flour post-refinement is not viable for health benefits and regular consumption may lead to micronutrient deficiencies or hidden hunger. Nevertheless, this food product is also suitable for nutritional improvements in the form of augmenting their vitamin and mineral content. Moreover, this assortment has the potential to add variations to our dull dietary lifestyle.

Studies on nutraceutical ingredients such as defatted soya flour (DSF), tomato, ginger etc. showed that the bioactive compounds *viz.,* genistein, lycopene and gingerol found in the above-mentioned nutraceuticals have protective effects against lifestyle diseases. Moreover, bioactive compounds have outstanding efficacy against prostate cancer cells, targeting cell cycle regulation from initiation to apoptosis through regulation of both and rogen and estrogen receptors; and interfering in the prostaglandin pathway during *in vitro* trials (Swami *et al.,* 2007 and Mukhopadyay, 2010). Alongside, whole grains with plenty of dietary fiber and bioactive compounds also have health benefits containing alkylresorcinols, which increase urinary C-Peptide excretion and significantly ($p< 0.001$) decline the plasma Prostate-Specific Antigen (PSA) during prostate cancer (Landberg *et al.,* 2010). Early detected prostate cancer was reversed through exercising dietary changes. For instance, replacing the basic dietary ingredients with soy diet as it abets creating testosterone scarcity in males (Ansari, 2002).

Despite attaining the food security by developing nations like India, hidden hunger in form of various micronutrient deficiencies such as Vitamin A deficiency, iron deficiency etc. have been remaining the major health challenges for vulnerable groups *i.e.,* women and children. In addition to this, dietary supplements under different prophylaxis programmes were not consumed by the target groups, on regular basis. Besides, designer foods are in vogue during contemporary era among all age groups due to scarcity of time. Hence, value added products containing locally available nutraceutical ingredients can play a role in combating micronutrient deficiencies on sustainable basis owing to their cost-effectiveness and frequent consumption.

Various researchers developed value added noodles enriched with functional ingredients such as fenugreek flour, jackfruit seeds, DSF, citrus peel powder etc. at different supplementation levels in wheat flour and found the final product nutritionally improved with good sensory acceptability (Dhull and Sandhu, 2018; Nandkule *et al.,* 2015; Pakhare *et al.,* 2016 and Lutz *et al.,* 2015). Further, the product's micronutrient composition and nutrient bioavailability is dependent on type of extrusion technology (Azam and Pandey, 2023). Taking previous research investigations into consideration, noodles can be modified with a mixture of locally available nutraceutical ingredients to enhance their micronutrient profile. Hence, the present study aims at investigating and comparing the vitamin, mineral content and total phenol content of noodles and flavours through blending different nutraceutical ingredients with WF.

Material and Methods

Development and Sensory Acceptability

Four formulations (T1, T2, T3 and T4) each of noodles and flavours (F1, F2 and F3) were developed. For noodle formulations, cold extrusion technique was employed, followed by drying at 60°C in hot air oven. Raw noodles were evaluated for five different sensory parameters to find out the most acceptable treatment. The descriptive ratio of noodles and flavours are discussed under Table 1.

Table 1

Treatments of noodles and flavours

Ingredients	T_1 (g)	T_2 (g)	T_3 (g)	T_4 (g)
Noodles				
Defatted Soya Flour	-	60	50	40
Wheat Flour	100	40	50	60
Flavours				
		F_1 (g)	F_2 (g)	F_3 (g)
Tomato		6	6	6
Ginger		1	2	-
Tangerine Peel Powder		1	-	2
Turmeric		1.5	1.5	1.5
Salt		10	10	10
Black Pepper		0.50	0.50	0.50

Chemical Analysis

Nutraceutical ingredients, noodles and flavours were analyzed for Vitamin A (AOAC, 1980), Vitamin C (AOVC, 1996) and Vitamin E (Emmerie and Engel, 1938) content and mineral content (calcium, phosphorus, iron and zinc) by Inductively Coupled Plasma Atomic Emission Spectroscopy (Dilek *et al.,* 2011), respectively. Total Phenol Content (TPC) was assessed with the standard method (Singleton *et al.,*1999).

Statistical Analysis

Data was analysed by applying Tukey's test, One-way ANOVA (Analysis of Variance) (Graph Pad Prism software 2007 (version 5.01)) to study the significant difference ($P<0.05$) between all the parameters recorded.

Results and Discussion

Sensory Acceptability of Noodles and Flavours

Among noodles, T4 was a highly acceptable treatment with mean overall acceptability (O.A.) score and

TABLE 2

Sensory evaluation of noodles and flavours

Parameters	Appearance	Colour	Texture	Flavour	O. A.
Noodles					
T_1	7.5 ± 0.15 [b]	7.0 ± 0.10 [d]	7.5 ± 0.50 [b]	7.0 ± 0.25 [b]	7.2 ± 0.20 [b]
T_2	6.5 ± 0.10 [d]	7.0 ± 0.15 [c]	6.5 ± 0.20 [d]	6.0 ± 0.30 [d]	6.5 ± 0.50 [d]
T_3	7.0 ± 0.20 [c]	7.5 ± 0.10 [b]	7.0 ± 0.15 [c]	6.5 ± 0.20 [c]	7.0 ± 0.30 [c]
T_4	8.0 ± 0.05 [a]	8.0 ± 0.15 [a]	7.5 ± 0.25 [a]	7.5 ± 0.50 [a]	7.7 ± 0.25 [a]
Flavours					
F_1	6.7 ± 0.29 [c]	6.3 ± 0.15 [c]	6.1 ± 0.30 [c]	6.3 ± 0.15 [c]	6.0 ± 0.00 [c]
F_2	7.1 ± 0.30 [a]	7.2 ± 0.50 [b]	7.2 ± 0.50 [a]	7.3 ± 0.29 [a]	7.8 ± 0.29 [a]
F_3	7.0 ± 0.00 [b]	7.3 ± 0.10 [a]	7.1 ± 0.30 [b]	6.5 ± 0.50 [b]	7.2 ± 0.30 [b]

*Values are Mean ± SD from ten determinations; different superscripts in the same column are significantly different ($p<0.05$)

Where, T_1 = 100 per cent Wheat Flour; T_2 = 60 per cent Defatted Soya Flour, 40 per cent Wheat Flour; T_3 = 50 per cent Defatted Soya Flour, 50 per cent Wheat Flour; T_4 = 40 per cent Defatted Soya Flour, 60 per cent Wheat Flour

Where, F_1 = Tomato (60 per cent) + Ginger (10 per cent) + Tangerine Peel Powder (10 per cent) + Turmeric (7.5 per cent) + Salt (10 per cent) + Black Pepper (2.5 per cent); F_2 = Tomato (60 per cent) + Ginger (20 per cent) + Turmeric (7.5 per cent) + Salt (10 per cent) + Black Pepper (2.5 per cent); F_3 = Tomato (60 per cent) + Tangerine Peel Powder (20 per cent) + Turmeric (7.5 per cent) + Salt (10 per cent) + Black Pepper (2.5 per cent)

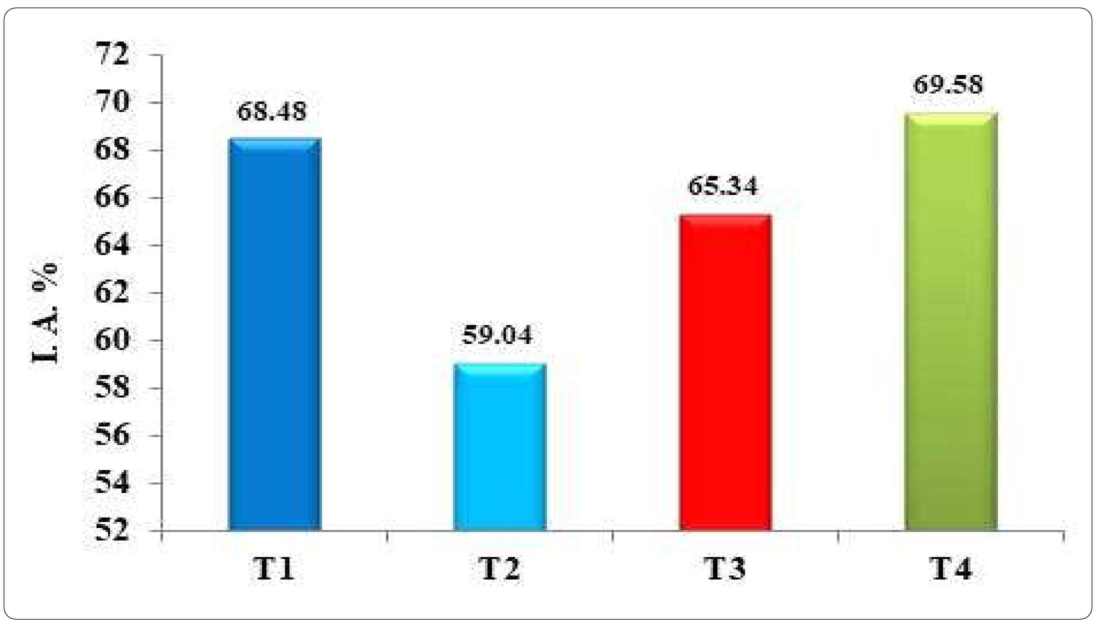

Fig. 1 : Index of Acceptability (I.A.) of noodles

I.A. percentage of 7.7 and 69.58, respectively (Table 2, Fig. 1). Similarly, for flavours, F2 was the most acceptable treatments with O.A. score and I.A. percentage of 7.8 and 65.88 (Table 2, Fig. 2), correspondingly.

Vitamin Content

The vitamin content of nutraceutical ingredients, noodles and flavours has been presented in Table 3. The average vitamin A content was 16.13, 219.6,

TABLE 3

Vitamin content of nutraceutical ingredients, noodles and flavours

Sample	Vitamin-A (µg/ 100 g)	Vitamin-C (mg/ 100 g)	Vitamin-E (mg/ 100 g)
Nutraceutical Ingredients			
Defatted Soya Flour	402 ± 1.98 [b]	0.0 ± 0.0	0.07 ± 0.01 [d]
Wheat Flour	19.7 ± 0.2 [e]	0.0 ± 0.0	0.0 ± 0.0
Tomato	144 ± 1.23 [c]	26.1 ± 0.05 [b]	0.91 ± 0.06 [a]
Tangerine Peel	554.2 ± 4.14 [a]	28.7 ± 1.24 [a]	0.26 ± 0.02 [c]
Ginger	24.2 ± 0.37 [d]	3.1 ± 0.12 [c]	0.0 ± 0.0
Noodles			
T_1	16.13 ± 1.20 [d]	0.0 ± 0.0	0.02 ± 0.0 [d]
T_2	219.6 ± 4.70 [a]	0.0 ± 0.0	0.07 ± 0.03 [a]
T_3	186.2 ± 2.20 [b]	0.0 ± 0.0	0.04 ± 0.0 [b]
T_4	179.4 ± 3.05 [c]	0.0 ± 0.0	0.03 ± 0.0 [c]
Flavours			
F_1	10.8 ± 0.2 [b]	1.0 ± 0.05 [a]	0.03 ± 0.01 [a]
F_2	4.5 ± 0.1 [c]	0.79 ± 0.04 [c]	0.02 ± 0.0
F_3	13.4 ± 0.75 [a]	0.92 ± 0.08 [b]	0.03 ± 0.0

*Values are Mean ± SD from triplicate determinations; different superscripts in the same column are significantly different (P<0.05)

Where, T_1 = 100 per cent Wheat Flour; T_2 = 60 per cent Defatted Soya Flour, 40 per cent Wheat Flour; T_3 = 50 per cent Defatted Soya Flour, 50 per cent Wheat Flour; T_4 = 40 per cent Defatted Soya Flour, 60 per cent Wheat Flour

Where, F_1 = Tomato (60 per cent) + Ginger (10 per cent) + Tangerine Peel Powder (10 per cent) + Turmeric (7.5 per cent) + Salt (10 per cent) + Black Pepper (2.5 per cent); F_2 = Tomato (60 per cent) + Ginger (20 per cent) + Turmeric (7.5 per cent) + Salt (10 per cent) + Black Pepper(2.5 per cent); F_3 = Tomato (60 per cent) + Tangerine Peel Powder (20 per cent) + Turmeric (7.5 per cent) + Salt (10 per cent) + Black Pepper (2.5 per cent)

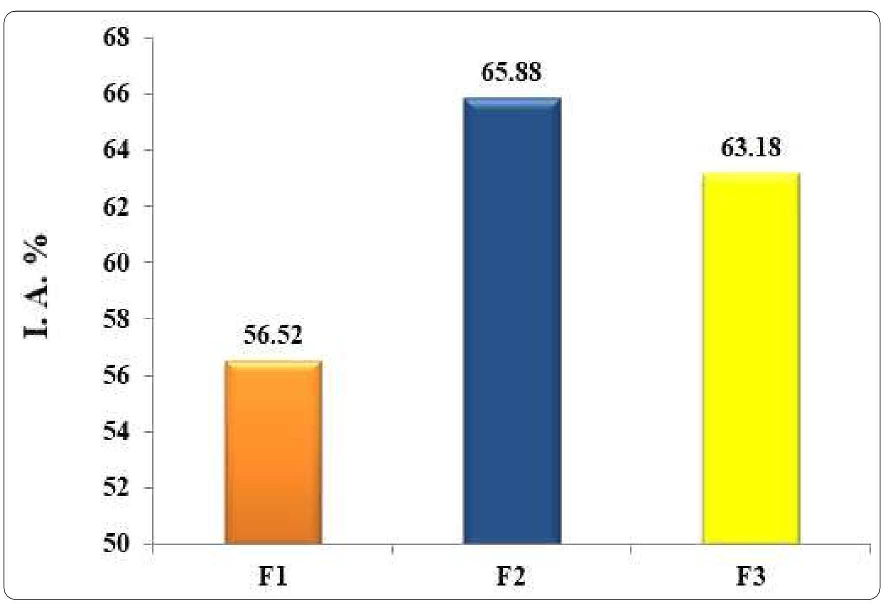

Fig. 2 : Index of Acceptability (I.A.) of flavours

TABLE 4

Mineral content of nutraceutical ingredients, noodles and flavours

Sample	Calcium (mg/ 100 g)	Phosphorus (mg/ 100 g)	Iron (mg/ 100 g)	Zinc (mg/ 100 g)
Nutraceutical Ingredients				
Defatted Soya Flour	201.4 ± 1.2 a	663.4 ± 1.56 b	6.7 ± 0.8 b	2.1 ± 0.12 b
Wheat Flour	18.9 ± 0.61 e	108.9 ± 0.33 c	1.9 ± 0.2 e	0.45 ± 0.07 e
Tomato	12.14 ± 0.56 f	31.6 ± 0.17 e	1.1 ±0.04 f	0.0 ± 0.0 f
Tangerine Peel	157.3 ± 1.16 b	17.1 ± 0.31 f	7.87 ± 0.4 a	6.96 ± 0.34 a
Ginger	61.2 ± 0.32 c	53.8 ± 0.42 d	2.7 ± 0.3 d	0.67 ± 0.03 d
Noodles				
T_1	90.6 ± 1.9 d	409.2 ± 8.00 a	3.87 ±0.21 d	1.09 ± 0.03 d
T_2	124.3 ± 2.0 a	398.4 ± 5.15 b	4.69 ±0.13 a	1.81 ± 0.3 a
T_3	120.6 .± 3.9 b	352.8 ± 2.96 c	4.50 ±0.15 b	1.40 ± 0.2 b
T_4	107.4 ± 3.1 c	296.4 ± 4.05 d	4.12 ±0.10 c	1.25 ± 0.1 c
Flavours				
F_1	0.61 ± 0.05 a	1.52 ± 0.08 a	0.06 ±0.01 a	0.03 ± 0.0 b
F_2	0.56 ± 0.03 c	1.12 ± 0.03 c	0.04 ± 0.0 b	0.0 ± 0.0
F_3	0.59 ± 0.02 b	1.26 ± 0.04 b	0.02 ± 0.0 c	0.12 ± 0.01 a

*Values are Mean ± SD from triplicate determinations; different superscripts in the same column are significantly different (P<0.05)

Where, T_1 = 100 per cent Wheat Flour; T_2 = 60 per cent Defatted Soya Flour, 40 per cent Wheat Flour; T_3 = 50 per cent Defatted Soya Flour, 50 per cent Wheat Flour; T_4 = 40 per cent Defatted Soya Flour, 60 per cent Wheat Flour

Where F_1 = Tomato (60 per cent) + Ginger (10 per cent) + Tangerine Peel Powder (10 per cent) + Turmeric (7.5 per cent) + Salt (10 per cent) + Black Pepper (2.5 per cent); F_2 = Tomato (60 per cent) + Ginger (20 per cent) + Turmeric (7.5 per cent) + Salt (10 per cent) + Black Pepper(2.5 per cent); F_3 = Tomato (60 per cent) + Tangerine Peel Powder (20 per cent) + Turmeric (7.5 per cent) + Salt (10 per cent) + Black Pepper (2.5 per cent)

186.2 and 179.4 µg/100g in T1, T2, T3 and T4, respectively. Vitamin C content in all the samples reported with 0.00mg/100g amount. Because the cereals and pulses do not contain vitamin C, hence the noodles do not contain vitamin C. The highest (0.07mg/100g) vitamin E content was observed in the T2 treatment of noodles. On the other hand, T1 was found lacking in vitamin E content.

Vitamin A content of flavours ranged from 4.5 to 13.4 µg. F3 has been reported with the highest amounts while F2 possessed the least amount. Further, 10.8 µg of vitamin A was reported in F1. Higher content of Vitamin C was observed in F1 (1.0mg) as compared to F2 (0.79mg) and F3 (0.92mg), respectively. Negligible amounts (0.03, 0.02 and 0.03mg) of vitamin E were reported in F1, F2 and F3, respectively.

Mineral Content

The values for minerals (calcium, phosphorus, iron and zinc) in nutraceutical ingredients, noodles and flavours are reported in Table 4. Calcium content was ranged from 90.6 to 124.3mg. The maximum amount of this mineral was found in T2 (124.3mg/100g) and the minimum was observed in T1 (90.6mg/100g), respectively. On the other side, T3 (120.6mg/100g) has been observed with good amount of calcium. Furthermore, iron ranged from 3.87 to

4.69mg/100g of sample, where T2 and T3 were observed with almost close figures *i.e.*, 4.69 and 4.50mg/100g of sample. The values for zinc content ranged from 1.09 to 1.81mg and a higher amount of zinc was recorded in T2 while the lesser value was there in the control sample *i.e.,*T1.

Among noodle flavours, calcium ranged from 0.56 to 0.61mg/100g of the sample. Maximum amounts of calcium (0.61mg/100g) and phosphorus (1.52mg/100g) were found in F1 followed by F3 (0.59mg/100g calcium and 1.26mg/100g phosphorus) and F2 (0.56mg calcium and 1.12mg/100g phosphorus), respectively. The figures for iron & zinc content were observed as 0.06 & 0.03, 0.04 & 0.00 and 0.02 & 0.12mg in F1, F2 and F3, respectively.

Total Phenol Content (TPC)

TPC of four noodle samples ranged from 70.25 to 234.5mgGAE/100g (Table 5). In case of noodles, TPC of T2, T3 and T4 (234.5±7.10, 100.8±3.05 and 85.4±2.15mgGAE/100g) was significantly ($P<0.05$) lower than T1 (70.25±4.1mgGAE/100g). Findings on the TPC of three noodle flavours revealed that F1, F2 and F3 had 7.04, 6.72 and 6.91mgGAE in 100g of TPC, correspondingly.

Sensory evaluation is considered as a reliable tool to analyse consumer's preferences for the developed food product. With regard to present investigation, 40 per cent DSF was found suitable in the preparation of wheat-soya noodles. Several studies have shown the appropriate blend of staple food ingredients. In this regard, a fortified pasta noodles from wheat and millet flour blends as 100:0, 50:50 and 70:30 were prepared and analysed for sensory parameters. The findings indicated 30 per cent millet flour as the most acceptable treatment (Serwaa *et al.,* 2021). Similarly, soy protein isolate was added to high-gluten flour at different concentrations from 5 to 20 per cent. It was observed that with increasing concentration of soy protein isolate, a continuous decline in brightness and yellowness of noodles was there (Liang *et al.,* 2023). Further, five treatments of soy flour was prepared by blending it with rice flour at 10, 15, 20, 25 and 30 per cent level. The results showed that colour of noodles was improved with the increased fortification of soy and the most acceptable incorporation level of soy was 15 per cent (Bolarinwa and Oyesiji, 2021).

TABLE 5

Total phenol content of nutraceutical ingredients, noodles and flavours

Sample	Total Phenols (mg GAE/ 100 g)
Nutraceutical Ingredients	
Defatted Soya Flour	164.3 ± 2.49 [b]
Wheat Flour	10.8 ± 0.51 [e]
Tomato	221.6 ± 2.54 [a]
Tangerine Peel	31.72 ± 1.02 [c]
Ginger	12.4 ± 0.74 [d]
Noodles	
T_1	70.25 ± 4.1 [d]
T_2	234.5 ± 7.10 [a]
T_3	100.8 ± 3.05 [b]
T_4	85.42 ± 2.15 [c]
Flavours	
F_1	7.04 ± 0.4 [a]
F_2	6.72 ± 0.35 [c]
F_3	6.91 ± 0.11 [b]

*Values are Mean ± SD from triplicate determinations; different superscripts in the same column are significantly different ($p<0.05$)

Where T_1 = 100 per cent Wheat Flour; T_2 = 60 per cent Defatted Soya Flour, 40 per cent Wheat Flour; T_3 = 50 per cent Defatted Soya Flour, 50 per cent Wheat Flour; T_4 = 40 per cent Defatted Soya Flour, 60 per cent Wheat Flour

Where F_1 = Tomato (60 per cent) + Ginger (10 per cent) + Tangerine Peel Powder (10 per cent) + Turmeric (7.5 per cent) + Salt (10 per cent) + Black Pepper (2.5 per cent); F_2 = Tomato (60 per cent) + Ginger (20 per cent) + Turmeric (7.5 per cent) + Salt (10 per cent) + Black Pepper(2.5 per cent); F_3 = Tomato (60 per cent) + Tangerine Peel Powder (20 per cent) + Turmeric (7.5 per cent) + Salt (10 per cent) + Black Pepper (2.5 per cent)

For noodles, the highest amount of vitamin A has been observed in T2 (219.6mg/100g), since DSF contained a significantly ($p<0.05$) higher content of vitamin A as compared to wheat flour and higher proportion of

DSF was present in T2. All the noodle samples contain no vitamin C content in them as cereals and pulses are lacking in vitamin C. Noodle sample (T2) possessed the highest vitamin E content because WF and DSF (whole grains) contain tocopherols and tocotrienols (Soukoulis and Aprea, 2012). On the contrary, the control samples were having significantly ($p<0.05$) lower amounts of vitamin E content as they contained no DSF.

Regarding the vitamin A content of flavours, F3 had the highest value while F2 was reported with the lowest value. Further, it was reported as 10.8µg in F1. A significant ($P<0.05$) augmentation in β-carotene content was reported when tomato peel was added to durum wheat meal at 10 and 15 per cent level (Padalino *et al.,* 2017). Thus, by incorporating natural flavours such as tomato and other fruit and vegetable by-products, the amount of vitamin A and C can be increased and the losses that occur during milling process of flour can be compensated (Li *et al.,* 2014). Alike findings were reported during present study.

T2 and T1 contained a higher content of calcium and phosphorus as compared to other noodle samples. T2 and T3 had good amounts of iron. Further, higher amount of zinc was reported in T2 while the lesser value was T1. The mean content of minerals increased on 10 per cent higher supplementation level of DSF to cereal flour. It was also reported a significant ($P<0.05$) increase in calcium and iron content of functional noodles developed with wheat and black gram flour blend (85: 15) (Anjali and Rani, 2018). Similarly, a significant ($P<0.05$) increase in calcium and iron contents in noodles prepared from wheat flour and soya flour along with jackfruit and pearl millet flours (Kumari *et al.,* 2018). An increase in calcium, phosphorus, iron and zinc contents at 10 per cent increased level of soya flour to whole wheat and pearl millet flours were also reported (Thilagavathi *et al.,* 2015). Higher content of calcium and phosphorus was observed in flavours *i.e.,* F1 and F3 than F2, respectively. Phosphorus and iron content were significantly ($P<0.05$) increased during the incorporation of tomato paste to wheat-pearl millet pasta (Yadav *et al.,* 2014). Similar findings were reported by Somitha *et al.,* 2024 during evaluation of extruded products developed using jack fruit, breadfruit and oyster mushroom flours.

During present study, in noodles, T2 contained the highest amount of total phenols in it while T1 was reported with the lowest. This may be due to a higher amount of whole grain (defatted soya flour) consisting of ferulic acid (a phenolic compound) and also present in the outer layer of wheat, has the capacity to quench free radicals (Nystrom *et al.,*2007). TPC of the final product is increased when the composite flour mixture contains whole grain flours instead of refined flours (Scalbert and Williamson, 2000). A significant ($P<0.05$) increase was noted in polyphenol content of wheat-black gram flour blended noodles (Kumari *et al.,*2018).

These findings for flavours revealed the range of total phenol content in three flavours from 6.72 to 7.04 mgGAE/100g, which were prepared with the incorporation of all the functional ingredients such as tomato, ginger, tangerine peel powder and turmeric. It can also be explained that dehydrating tomato and other functional ingredients with phenolic content have the potential to enhance their total phenolic content by almost 30 times after the drying process and further, mixing all the functional ingredients with bioactive compounds such as tomato, ginger, tangerine peel powder and turmeric combined, can help to achieve the significantly ($P<0.05$) enhanced total phenol content in the final product (Lutz *et al.,*2015). Moreover, phenolic compounds present in orange peels help in improving the vitamin and total phenol content of the developed extruded products such as noodles as they possess flavonoids (Ademosun, 2022; Rawat, 2021 and Ji *et al.,*2017).

To recapitulate, composite flour by mixing DSF at 40per cent level and WF at 60 per cent level can be prepared for noodles. Different locally available nutraceutical ingredients can be blended together for attaining higher phenol content in the final product. These formulations also contribute towards improved nutritional quality of noodles in terms of enhanced vitamin and mineral content for maintaining good nutritional status.

References

Ademosun, A. O., 2022, Citrus peels odyssey: From the waste bin to the lab bench to the dining table. *Appl Food Res.,* **2 (1)** : 100-108.

Anjali and Rani, V., 2018, Nutritional composition of functional extrudates developed from wheat and black gram. *Int J. Curr. Microbiol. Appl. Sci.,* **7 (8)** : 375 - 381.

Ansari, M. S., 2002, Prostate cancer and nutritional issues. *Indian J. Nutr. Diet.,* **39** : 237 - 244.

Aoac, 1980, Official methods of analysis. 17th ed. Association of Official Analytical Chemist. Washington, DC.

Aovc, 1996, Official methods of analysis.17th ed. Association of Official Analytical Chemist. Washington, DC.

Azam, M. and Pandey, S., 2023, Effects of extrusion on the nutritional properties of milliet based extruded products - A Review. *Mysore J. Agric. Sci.,* **57 (3)** : 1 - 14.

Bolarinwa, I. F. and Oyesiji, O. O., 2021, Gluten free rice-soy pasta: Proximate composition, textural properties and sensory attributes. *Heliyon,* **7** (1).

Dhull, S. B. and Sandhu, K. S., 2018, Wheat-fenugreek composite flour noodles: Effect on functional, pasting, cooking and sensory properties. *Curr. Res. Nutr. Food Sci.,* **6** (1) : 174 - 182.

Dilek, B., Kurtulus, Y. B. and Ucar, G., 2011, Determination of some trace metal levels in cheese samples packaged in plastic and tin containers by ICP-OES after dry, wet and microwave digestion. *Food Chem. Toxicol.,* **49** : 202 - 207.

Emmerie, A. and Chr. Engel, 1938, Colorimetric determination of į-tocopherol (Vitamin E). *RTCPB 4,* **57** (12) : 1351 - 1355.

Graphpad Prism Software, 2007, Version 5.01 for Windows. Dotmatics, San Diego, California, USA.

Ji, P., Ji, X., Fu, S. and Zhang, L., 2017, Study on nutrition fresh noodles formulated with pomelo peel and peach gum. *F&F Ind.,* **43** (1) : 156 - 162.

Kumari, S., Prasad, R. and Gupta, A., 2018, Processing and utilization of jackfruit seeds, pearl millet and soybean flour for value addition. *J. Pharmacogn. Phytochemist,* **7** (6) : 569 - 572.

Landberg, R., Anderson, S. O., Zhang, J. X., Johansson, J. E., Stenman, U. H., Adlercreutz, H., Kamal-Eldin, A., Per Aman and Hallmans, G., 2010, Rye whole grain and bran intake compared with refined wheat decreases urinary c-peptide, plasma insulin and prostate specific antigen in men with prostate cancer. *J. Nutr.,* pp. : 2180 - 2186.

Li, M., Zhu, K. X., Guo, X. N., Brijs, K. and Zhou, H. M., 2014, Natural additives in wheat-based pasta and noodle products: Opportunities for enhanced nutritional and functional properties. *Compr. Rev. Food Sci. Food Saf.,* **13** (4) : 347 - 357.

Liang, J. N., Nargotra, P., Li, X. Y., Sharma, V., Hsieh, S. L., Tsai, Y. H., Liu, Y. C., Huang, C. Y. and Kuo, C. H., 2023, Evaluation of wheat noodles supplemented with soy protein isolate for nutritional, textural, cooking attributes and glycemic index. *Appl. Sci.,* **13**.

Lutz, M., Hernandez, J. and Henriquez, C., 2015, Phenolic content and antioxidant capacity in fresh and dry fruits and vegetables grown in Chile. *CYTA-J Food,* **13** (4) : 541 - 547.

Mukhopadyay, A., 2010, Natural products in cancer therapy and prevention.*Indian J. Nutr. Diet.,* **47** : 364 - 377.

Nandkule, V. D., Masih, D., Sonkar, C. and Patil, D. S., 2015, Development and quality evaluation of jackfruit seed and soy flour noodles. *Int. J. Sci. Eng. Technol.,* **3** (3) : 802 - 806.

Nystrom, L., Achrenius, T., Lampi, A. M., Moreau, R. A., and Piironen, V., 2007, A comparison of the antioxidant properties of sterylferulates with tocopherol at high temperatures. *Food Chem.,* **101** : 947 - 954.

Padalino, L., Conte, A., Lecee, L., Likyova, D., Sicari, V., Pellicano, T. M., Poiana, M. and Del Nobile, M. A., 2017, Functional pasta with tomato by-product as a source of antioxidant compounds and dietary fibre. *Czech J. Food Sci.,* **35** (1) : 48 - 56.

Pakhare, K. N., Dagadkhair, A. C., Udachan, I. S. and Andhale, R. A., 2016, Studies on preparation and quality of nutritious noodles by incorporation of defatted rice bran and soy flour. *J. Food Process. Technol.,* **7** (1).

Rawat, D., 2021, Fortification of orange peel powder in vermicelli: A review. J.E.T.I.R.,**8** : 449 - 456.

Scalbert, A. and Williamson, G., 2000, Dietary intake and bioavailability of polyphenols. *J. Nutr.,* **130** : 2073S - 2085S.

Serwaa, A., Dorothy, A. and Abayase, R., 2021, Nutritional composition and sensory evaluation of wheat and millet flour pasta noodles. *Int. J. Acad. Appl. Res.,* **5** (1) : 136 - 141.

Singleton, V. L., Orthofer, R., Lamuela-Raventos, R. L., 1999, Analysis of total phenols and other oxidation substrates and oxidants by means of folin-ciocalteu reagent. *Methods Enzymol.,* **299** : 152 - 178.

Somitha, N. S., Thomachan, S., Sudheer, K. P., Sharon, C. L., Lakshmy, P. S. and Vidya, T. A., 2024, Development and evaluation of ready to cook extruded food from mushroom and fruit flours. *Mysore J. Agric. Sci.,***58** (1) : 358 - 366.

Soukoulis, C. and Aprea, E., 2012, Cereal bran fractionation: Processing techniques for the recovery of functional components and their applications to the food industry. *Recent Pat. Food Nutr. Agric.,* **4** : 61 - 77.

Swami, S., Krishnan, A. V., Moreno, J., Bhatacharyya, R. V., Peehl, D. M. and Feldman, D., 2007, Calcitriol and genistein actions to inhibit the prostaglandin pathway: Potential combination therapy to treat prostate cancer. *J. Nutr.,* **137** (1) : 205S - 210S.

Taneya, M. L. J., Biswas, M. M. H. and Shams-Ud-Din, M., 2014,The studies on the preparation of instant noodles from wheat flour supplementing with sweet potato flour. *J. Bangladesh Agril. Univ.,* **12** (1) :135 - 142.

Thilagavathi, T., Kanchana, S., Banumathi, P. and Ilamaran, M., 2015, Standardization of extruded products using modified millet flour and pulse flour. *Int. J. Food Nutr. Sci.,* **4** : 73 - 79.

Yadav, D. N., Sharma, M., Chikkara, N., Anand, T. and Bansal, S., 2014, Quality characteristics of vegetable blended wheat-pearl millet composite pasta. *Agric. Res.,* **3** : 263 - 270.