International Journal of Food and Fermentation Technology
Citation: *Int. J. Food Ferment. Technol.*, **14**(02): 665-674, December 2024
DOI: 10.30954/2277-9396.02.2024.13

ASSOCIATION FOR AGRICULTURE ENVIRONMENT AND BIOTECHNOLOGY

Research Paper

Nutritional Quality Assessment of Noodles with Assorted Nutraceuticals

Piverjeet Kaur Dhillon[1], Beenu Tanwar[2], Rasane Prasad Jayprakash[3] and Priya Singla[4*]

[1]Farm Science Centre, Guru Angad Dev Veterinary and Animal Sciences University, Booh, Harike Pattan, Tarn Taran, Punjab, India
[2]Department of Dairy Technology, Mansinhbhai Institute of Dairy and Food Technology, Dudhsagar Dairy Campus, Mehsana, Gujarat, India
[3]Department of Food Technology and Nutrition, Lovely Professional University, Phagwara, India
[4]Desh Bhagat University, Mandi Gobindgarh, Punjab, India

*Corresponding author: priya1988@pau.edu

Paper No.: 308 **Received:** 10-09-2024 **Revised:** 01-11-2024 **Accepted:** 08-12-2024

ABSTRACT

Three treatments (T_2, T_3 and T_4) of noodles were optimized through mixing wheat flour (WF) and defatted soya flour (DSF) at different concentrations (40:60, 50:50 and 60:40), correspondingly whereas T_1 was treated as control sample. Besides, three noodle flavours by incorporating blend of nutraceuticals were too standardized. Then, the developed products were assessed and compared for sensory parameters, proximate composition, *in vitro* protein digestibility and amino acid content. T_4 (with 40% DSF) was the most acceptable treatment in terms of its all sensory attributes. Index of Acceptability (I.A) of T_4 was 69.58%, respectively. Among noodle flavours, T_2 was highly acceptable. Proximate composition of noodles revealed > threefold increase in protein and ash content; and almost two fold increase in fiber content. Lysine content of noodles was also increased after addition of DSF. The highest *in vitro* protein digestibility was found in T_2 and T_3.

Keywords: Noodles, Noodle flavours, Nutraceutical ingredients, Nutritional quality, Sensory evaluation

In contemporary era, among various contributory factors for disease development and progression, diet and lifestyle have supremacy over other factors (Kowsalya *et al.* 2008; Saxena, 2015). Dietary pattern affects both the frequency and advancement of the fatal diseases but the interactions to specific foodstuff and the bioavailability of its nutrients are not simple and are most likely to be influenced by hereditary factors (Swami *et al.* 2007). Nonetheless, nutritious diet and disease-free body share a positive interrelation to each other. Likewise, marginal or negligible consumption of protective foods such as fruits and vegetables has a role in development of lifestyle diseases such as diabetes mellitus, cancer etc. (Zhang *et al.* 2012). Moreover, higher intake of fast food *viz.* burgers, pizzas and noodles are continued to be in vogue the world over which is of high concern, since it contains lesser amount of fiber and essential nutrients, required for normal physiological functioning of human body.

Noodle is one of the most affordable and easily accessible designer food product, consists of wheat as its main ingredient (Ginting and Yulifianti,

How to cite this article: Dhillon, P.K., Tanwar, B., Jayprakash, R.P. and Singla, P. (2024). Nutritional Quality Assessment of Noodles with Assorted Nutraceuticals. *Int. J. Food Ferment. Technol.*, **14**(02): 665-674.

Source of Support: None; **Conflict of Interest:** None

2015). It can be developed from single or variety of dough formulated into stripes, thin ribbons, curl-cues, pipes, waves etc. and is cooked with addition of fat and water (Shah and Jetwat, 2012). In modern times, due to lifestyle changes most of the population prefer ready to cook foods such as instant noodles but these products are loaded with saturated fats and artificial flavours. These products provide energy dense nutrients especially carbohydrates and fat but lack in micronutrients, which causes obesity with micronutrient deficiencies. Unfit diet (low in dietary fiber and antioxidants) leads to risk for developing chronic diseases like cancer. Despite poor health concerns, world consumption of instant noodles was recorded 101.514 million servings per year during the years 2011 to 2015 (World Instant Noodles Association, 2015). India has also become the second largest market for noodles since 2014 with number of brands (Kanteti, 2015). Usually, instant noodles are prepared from refined WF lacking in important nutrients. However, noodles and pasta products are recognized as important carriers of nutrient by WHO & US-FDA (Chillo *et al.* 2009). With increased awareness about nutrition among consumers, the food related industries has also been laying emphasis on production of functional foods by exercising nutraceutical value addition.

Nutraceutical ingredients provide health benefits by preventing diseases through increasing the antioxidant activity of the food product. These are helpful in enhancing food value with both special physical and psychological conditions (Ashwini *et al.* 2013). As being natural, these compounds have lesser side-effects as compared to traditional and modern medications. Nutraceuticals can be classified as nutrients, herbs or botanical extracts and dietary supplements (Sapkale Anita *et al.* 2012). The bioactive compounds, in the form of phytochemicals such as genistein present in soy, lycopene, curcumin and gingerol in tomatoes, turmeric and ginger, in that order, have been explored vis-à-vis their disease targeting potential during numerous scientific investigations (Rai *et al.* 2012). Considering these facts, a cost-effective and nutritious product should be formulated by blending natural ingredients to provide some amount of micro nutrients and non-nutritive components (Saharan and Jood, 2017). Therefore, the present study aimed at optimization of three different treatments of noodles along with natural flavours through amalgamating diverse array of nutraceuticals at different concentrations; and to evaluate and compare the nutritional facts of the noodles.

MATERIALS AND METHODS

Procurement of nutraceutical ingredients

Nutraceutical ingredients such as WF, wheat bran, and salt were purchased from local market at Phagwara, India. DSF (toasted) contained 0.5% fat and 50% protein, was used. Fresh ginger and tangerine peels were grated and dried at 60°C till the moisture content was declined to 8%. The dried ingredients were crushed in the grinder and sieved (through 1mm sieve-shaker); obtained fine ginger and tangerine peel powders were stored in food grade, air-tight containers at dry place. Tomatoes and butter (with 0% trans fat and cholesterol) were purchased at the time of preparation.

Optimizing noodles and noodle flavours

The optimization of noodles and noodle flavours has been shown in Fig. 1.

Method for preparation

After smooth dough was prepared, balls weighed 50g each were made and spread to sheets of 2mm thickness. A mesh was adjusted to extruder and inserted the sheets one by one in between two rollers fixed in the equipment. The extruded product was dried at 60°C in hot air oven for 1 hour.

Sensory evaluation: The sensory evaluation including five different attributes i.e. appearance, flavour (aroma/ taste), colour, texture, and O. A. was done using 9-point hedonic scale from 10 semi-trained judges and scores of each treatment of prepared assorted nutraceutical products (noodles and noodle flavours) were recorded. I. A. was calculated with the formulae given below:

$$\text{Index of acceptability} = \frac{\text{Total sum of all sensory parameters/No. of parameters}}{\text{Highest value of Hedonic Scale (9)}} \times 100$$

Nutritional quality assessment of noodles and noodle flavours

Chemical analysis: Nutraceutical materials and noodles and noodle flavours were analyzed for their proximate composition (AOAC, 2000), amino acid composition: lysine estimation (Carpenter, 1960); methionine estimation (Horn *et al.* 1946),

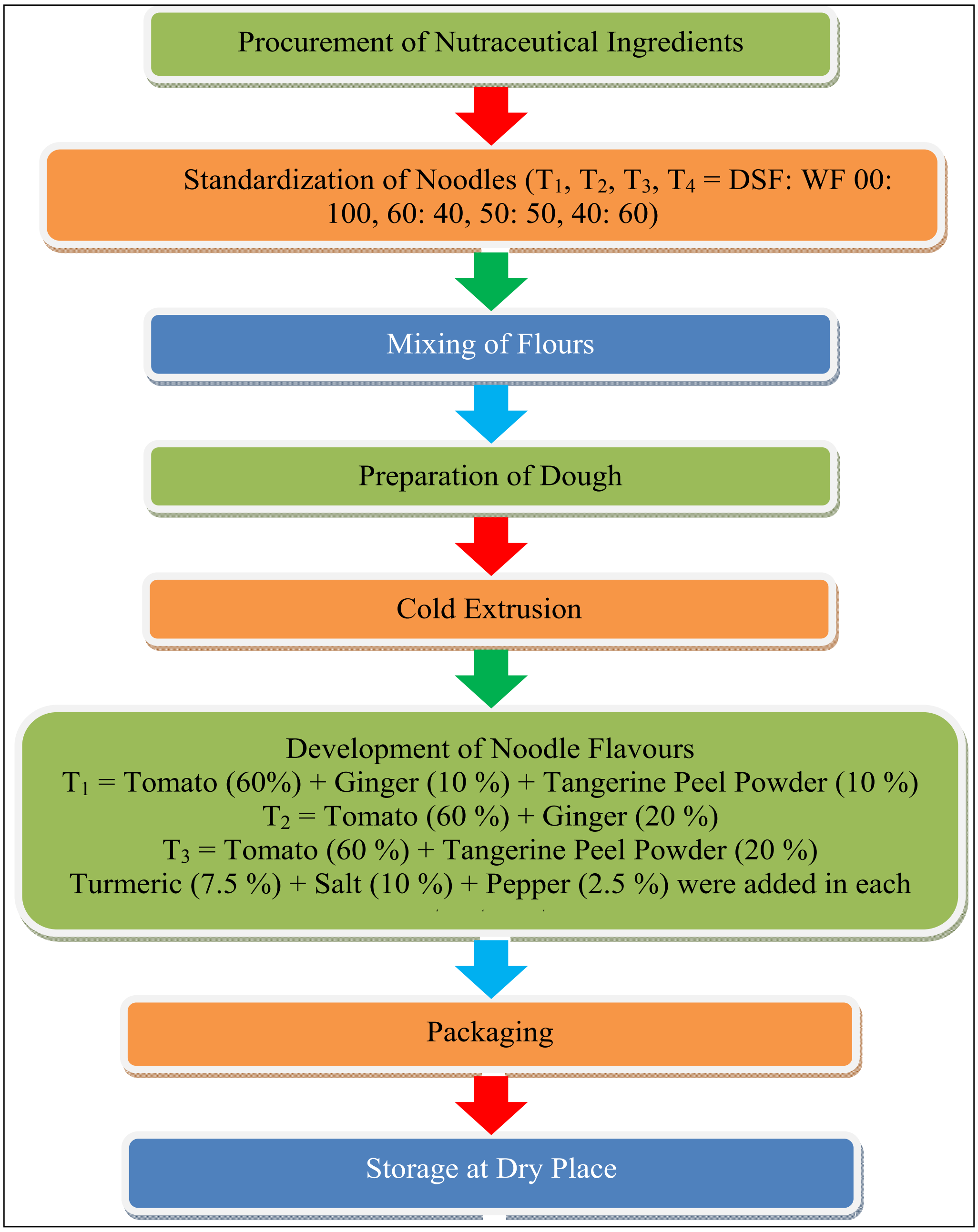

Fig. 1: Development of noodles and noodle flavours

trypsin inhibitor (Roy and Rao, 1971) and *in vitro* protein digestibility (Akeson and Stachman, 1964) in triplicates, on wet weight basis to determine nutritional quality of developed treatments.

Statistical analysis: Tukey's test, One-way ANOVA (analysis of variance) was used to analyse the difference at 5% level of significance between all the parameters recorded under physico-chemical evaluation at GraphPad Prism software (version 5.01).

RESULTS AND DISCUSSION

Sensory evaluation of noodles and noodle flavours

Sensory characteristics of noodles and noodle flavours are presented in Table 1. The mean scores of appearance of T_1, T_2 and T_3 were 7.5, 6.5 and 7.0, respectively. On the contrary, treatment (T_4) was the most acceptable with score of 8.0 with regard to their appearance. The average colour scores for T_1, T_2 and T_3 have been reported as 7.0, 7.0 and 7.5, respectively. Besides, T_4 scored highest (8.0 and 7.5) points for colour and texture when compared to the other treatments. The flavour of T_4 was better in assorted nutraceutical samples with average score of 7.5. Besides, T_1 has been reported with close value (7.0) under flavour attribute. Both T_2 and T_3 (6.5 and 7.0) were less acceptable with regard to their overall acceptability score while T_1 and T_4 were highly acceptable as the mean O. A. scores were 7.2 and 7.7, respectively. Similarly, T_1 and T_4 were most acceptable among all the treatments with I. A. percentage as 69.48 and 69.58, correspondingly.

The mean score of appearance of three noodle flavour treatments i.e. T_1, T_2 and T_3 were 6.7, 7.1 and 7.0, respectively. The average colour scores for T_1, T_2 and T_3 have been reported as 6.3, 7.2 and 7.3, respectively. Considering the scores obtained under texture, T_2 again found scoring highest (7.2) points trailing behind the other two T_1 and T_3 by 1.1 and 0.1 points, respectively. As flavour of the products was concerned, the difference found in scores of T_1 and T_3 was non-significant (p>0.05), during present study. Further, combining tomato with ginger (T_2) performed well with O. A. score of 7.8 while T_1 and T_2 had 6.0 and 7.2 O. A. score, respectively. In our study, addition of all nutraceuticals (T_1) resulted into least (56.52%) acceptable final product. Furthermore, T_2 was the most acceptable among all the treatments with I.A. as 65.88% (Table 1).

Accompanying natural functional ingredients to fast food is an effective way to compensate nutrient losses (Li *et al.* 2014). Apart from this, natural spices are used

Table 1: Sensory evaluation of noodles and noodle flavours

Parameters	Appearance	Colour	Texture	Flavour	O. A.	I. 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]	68.48
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]	59.04
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]	65.34
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]	69.58
Noodle flavours						
T_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]	56.52
T_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]	65.88
T_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]	63.18

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

Where T_1 = 100 % Wheat Flour; T_2 = 60 % Defatted Soya Flour, 40 % Wheat Flour; T_3 = 50 % Defatted Soya Flour, 50 % Wheat Flour; T_4 = 40 % Defatted Soya Flour, 60 % Wheat Flour; Where T_1 = Tomato (60 %) + Ginger (10 %) + Tangerine Peel Powder (10 %) + Turmeric (7.5 %) + Salt (10 %) + Black Pepper (2.5 %); T_2 = Tomato (60 %) + Ginger (20 %) + Turmeric (7.5 %) + Salt (10 %) + Black Pepper (2.5%); T_3 = Tomato (60 %) + Tangerine Peel Powder (20 %) + Turmeric (7.5 %) + Salt (10 %) + Black Pepper (2.5%).

in cooking in order to enhance flavour and physical appeal of the developed product. Therefore, noodles and noodle flavours were standardized. Wheat soya blended noodles in ratio of 75: 25 were most acceptable in terms of texture, colour, flavour, aroma and O. A. (Omeire *et al.* 2014). Besides, Shogren *et al.* 2006 revealed that 35% of soy flour incorporation to WF was highly acceptable for spaghetti with no significant difference (p>0.05) in flavour and texture of the product when compared to the control sample. In our investigation, dark colour of noodles might be due to high ash content in them (Ginting and Yulifianti, 2015). Bhise *et al.* 2015 reported the O. A. score of wheat soya (60: 40) noodles as 7.35 during their study. Sunil *et al.* 2019 formulated noodles (T90, T80, T70, T60 and T50 with control i.e. T100) by incorporating different proportions of soy bean, carrot, mushroom and apple pomace flours (2.5, 5, 7.5, 10 and 12.5% each, respectively) to WF (90, 80, 70, 60 and 50%) and evaluated the products in their sensory aspects. Mean colour scores were 8.6, 8.5, 8.4, 8.4, 8.2 and 8.0 for T90, T80, T70, T100, T60 and T50, respectively. Mishra and Bhatt, 2016 developed pasta by incorporating ginger powder at 1, 3 & 5% level to WF and reported the higher mean scores for colour, flavour and texture, at 1 and 3% level as compared to 5% incorporation level. Sunil *et al.* 2019 reported the range of O.A. score of noodles containing soy bean flour and vegetable powders between 7.55 and 8.27. The highest mean score was obtained in T90 and the lowest score was observed in T50. Addition of functional ingredients such as spinach up to 40% to WF noodle helps improving the O. A. score of the developed products (Shere *et al.* 2018). The present findings under sensory evaluation were in agreement with the results reported for bread wheat pasta with vegetable paste (Rekha *et al.* 2013). Similarly, the developed vegetable blended pasta through incorporating tomato at 25.5g/100g to wheat-pearl millet flour (90:10) and observed the O. A. score of 7.9 during sensory evaluation (Yadav *et al.* 2014). Likewise, highest overall acceptability score (7.85) in pasta sample fortified with ginger at 1% level was observed (Mishra and Bhatt, 2016), is found in agreement with the present study.

Nutritional quality assessment of nutraceutical ingredients

Proximate composition

The proximate composition of nutraceutical ingredients used, during preparation of noodles and noodle flavours has been presented in Table 2. Moisture content of basic flours i.e. DSF, refined WF and whole WF ranged between 7.79% and 11.4%. The corresponding values for moisture content in nutraceuticals such as wheat bran, tomato, tangerine peel powder and ginger were 7.27, 93.96, 7.9 and 8.2, respectively, in present investigation. The crude protein content was 59.21 and 9.26% in two flours i.e. DSF and WF. It was recorded that wheat bran, tomato, tangerine peel powder and ginger were containing 25.59, 1.57, 5.3 and 12.4% protein. Little fat percentage has been detected, in DSF (0.75) and tomato (0.28), among all the ingredients. Notable content of ash was observed in DSF (7.38%) followed by tangerine peel

Table 2: Proximate composition of nutraceutical ingredients

Sample	Moisture (%)	Protein (%)	Fat (%)	Fiber (%)	Ash (%)	Carbohydrate (%)
Defatted Soya Flour	7.79 ± 0.41^{e}	59.21 ± 0.91^{a}	0.75 ± 0.11^{e}	4.28 ± 0.18^{c}	7.38 ± 0.39^{a}	20.59 ± 0.41^{e}
Wheat Flour	11.4 ± 0.36^{b}	9.26 ± 0.28^{c}	1.15 ± 0.13^{d}	0.00 ± 0.00^{f}	0.60 ± 0.06^{e}	77.59 ± 0.59^{a}
Wheat Bran	7.27 ± 0.35^{f}	25.59 ± 0.88^{b}	4.62 ± 0.27^{b}	1.97 ± 0.21^{d}	2.12 ± 0.12^{d}	58.43 ± 0.44^{c}
Tomato	93.96 ± 0.26^{a}	1.57 ± 0.35^{f}	0.28 ± 0.04^{f}	0.85 ± 0.11^{e}	0.47 ± 0.16^{f}	2.87 ± 0.34^{f}
Tangerine Peel	7.9 ± 0.35^{d}	5.3 ± 0.11^{e}	2.2 ± 0.30^{c}	11.14 ± 0.22^{a}	4.48 ± 0.23^{c}	68.98 ± 0.42^{b}
Ginger	8.2 ± 0.36^{c}	12.4 ± 0.25^{d}	7.73 ± 0.25^{a}	10.47 ± 0.28^{b}	4.75 ± 0.14^{b}	56.45 ± 1.04^{d}

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

powder (4.48%), and ginger (3.75%), respectively. Further, the values for carbohydrate were reported as 20.59, 77.59, 58.43, 2.87, 68.98 and 56.45% in DSF, WF, wheat bran, tomato, tangerine peel powder and ginger, respectively. The observed proximate content was close to the reference values (Gopalan *et al.* 2004).

Amount of moisture present in the flour is dependent of, both atmospheric and processing conditions (Reddy *et al.* 2015). Pakhare *et al.* 2016 reported 8.43% moisture content in DSF incorporated at 10% level in refined WF. Suriya *et al.* 2017 reported the moisture range from 9.53 to 11.34% in while developing composite flour from refined WF and elephant foot yam flour, for development of functional cookies. Among nutraceutical ingredients, DSF had the highest protein content in our study, may be, because of high water holding capacity (Rababah *et al.* 2006; Ayele *et al.* 2017). Simultaneously, tangerine peel powder had higher (11.14%) amount of fiber than other nutraceuticals, since having fair amounts of pectin (Abou-Arab *et al.* 2017; Obafaye and Omoba, 2018). The findings of current study were in close agreement with USDA (10.68%) (USDA Food Composition databases, 2018). Also, higher amount of fiber present in tangerine peel might be, due to high amounts of total dry solids and emulsifying properties (Amin *et al.* 2017) and because of good amounts of potassium (Gopalan *et al.* 2004).

Amino acids, Trypsin Inhibitor and *In vitro* protein digestibility

Amino acids, trypsin inhibitor and *in vitro* protein digestibility of nutraceutical ingredients has been presented in Table 3. Lysine content ranged from 0.0 to 3.71g/100g protein. DSF and wheat bran contained 3.71 and 3.64g lysine/100g protein, respectively. Further, no amounts were recorded in ginger and tangerine peel powder. During present study, wheat bran was observed with 0.97g/100g protein) content of methionine. Similarly, in WF, DSF and tomato, it was 0.83, 0.71 and 0.42g/100g protein, respectively. Negligible amounts of this essential amino acid were recorded in tangerine peel powder and ginger. The figures for amino acid content corroborate with the reference values (Gopalan *et al.* 2004). In DSF, the amount of trypsin inhibitor was 4.7mg/g whereas it was not detected in other ingredients. Toasted defatted soya flour was used during present study and it was reported that trypsin inhibitor residues were present in the flour after toasting (Sessa and Bietz, 1986). *In vitro* protein digestibility was highest in DSF followed by WF and tomato, respectively.

Nutritional quality assessment of noodles and noodle flavours

Proximate composition

With regard to proximate composition of noodles and noodle flavours, the moisture content of T_2 (9.40%) was the highest as compared to other assorted nutraceutical treatments *viz.* T_3 (9.01%), T_4 (9.23%) as well as control i.e. T_1 (9.34%), correspondingly (Table 4). The percentage of crude protein was observed as 32.05 in T2 followed by 29.15 in T3, 27.65 in T4 and 8.20 in T1, respectively. Omeire *et al.* 2014 observed

Table 3: Amino acid composition, Trypsin Inhibitor and *In vitro* protein digestibility of nutraceutical ingredients

Sample	Lysine (g/ 100 g protein)	Methionine (g/ 100 g protein)	Trypsin Inhibitor (mg/g)	*In vitro* protein digestibility
Defatted Soya Flour	3.71±0.22[a]	0.71±0.05[c]	4.7±0.4[a]	67.28±1.74[a]
Wheat Flour	1.06±0.05[d]	0.83±0.02[b]	0.0±0.0	51.94±1.61[b]
Wheat Bran	3.64±0.21[b]	0.97±0.05[a]	0.0±0.0	28.03±0.90[e]
Tomato	1.44±0.12[c]	0.42±0.08[d]	0.0±0.0	50.31±1.46[c]
Tangerine Peel	0.0±0.0	0.0±0.0	0.0±0.0	18.58±0.49[f]
Ginger	0.0±0.0	0.0±0.0	0.0±0.0	35.83±0.64[d]

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

Table 4: Proximate composition of noodles and noodle flavours

Parameters	Moisture (%)	Protein (%)	Fat (%)	Fibre (%)	Ash (%)	Carbohydrate (%)
Noodles						
T_1	9.34±0.30[b]	8.20±0.13[d]	0.96±0.10[b]	1.65±0.20[d]	1.02±0.15[d]	78.83±0.19[a]
T_2	9.40±0.20[a]	32.05±0.26[a]	1.01±0.15[a]	2.46±0.15[a]	4.22±0.10[a]	50.86±0.16[d]
T_3	9.01±0.16[d]	29.15±0.32[b]	0.93±0.25[c]	2.32±0.15[b]	3.91±0.20[b]	54.69±0.28[c]
T_4	9.23±0.21[c]	27.65±0.20[c]	0.89±0.21[d]	2.03±0.31[c]	3.47±0.25[c]	56.72±0.21[b]
Noodle flavours						
T_1	59.2±0.02[a]	4.4±0.02[a]	2.2±0.01[a]	4.6±0.03[a]	1.8±0.01[a]	26.8±0.13[c]
T_2	57.6±0.08[b]	2.0±0.01[c]	0.6±0.0[c]	2.6±0.01[b]	1.0±0.0[b]	36.2±0.02[a]
T_3	57.8±0.08[b]	2.4±0.03[b]	1.6±0.0[b]	2.4±0.01[c]	1.0±0.01[b]	34.8±0.04[b]

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

Where, T_1 = 100 % Wheat Flour; T_2 = 60 % Defatted Soya Flour, 40 % Wheat Flour; T_3 = 50 % Defatted Soya Flour, 50 % Wheat Flour; T_4 = 40 % Defatted Soya Flour, 60 % Wheat Flour; Where, T_1 = Tomato (60 %) + Ginger (10 %) + Tangerine Peel Powder (10 %) + Turmeric (7.5 %) + Salt (10 %) + Black Pepper (2.5 %); T_2 = Tomato (60 %) + Ginger (20 %) + Turmeric (7.5 %) + Salt (10 %) + Black Pepper (2.5%); T_3 = Tomato (60 %) + Tangerine Peel Powder (20 %) + Turmeric (7.5 %) + Salt (10 %) + Black Pepper (2.5%).

13.38% crude protein in noodles prepared from composite flours using wheat and soya (75: 25). Bhise *et al.* 2015 also reported protein content as 23.77% in wheat soya noodles prepared in the ratio of 60:40. Further, Shogren *et al.* 2006 observed the higher protein content (33.5%) at 50% addition of soy flour to WF as compared to control (15.4%) sample. Crude fat was found maximum (1.01%) again in T_2 while recorded minimum (0.89%) in T4. Beniwal and Jood (2015) too reported the increased percentage of fat in cereal pulse based noodles when compared to control sample. Furthermore, a significant (p<0.05) difference was observed between the treatments with reference to fiber composition. The highest (2.46%) fiber content was observed in T_2 when compared to T_1, T_3 and T_4 (1.65, 2.32 and 2.03%), respectively. Similar results were reported by Beniwal and Jood (2015). Similarly, an increase of 0.65g/100g of sample was noted in functional noodles developed with 15% replacement of WF with black gram flour (Anjali and Rani, 2018). Regarding ash content, T_2 was having the maximum ash content i.e. 4.22% preceded by T_3 with the value of 3.91%. Simultaneously, T_4 and T_1 were reported with the figures as 3.47 and 1.02%, respectively. It was reported that the ash content was increased by almost double when refined WF was replaced with bengal gram and broken rice flour (at the rate of 20% each) during development of functional noodles (Beniwal and Jood, 2015). Pakhare *et al.* 2016 observed 1.54% ash on 10% replacement of refined WF with DSF. Maximum (78.83%) carbohydrate content was computed in T_1 variation whereas T_2 was found with 50.86% only. A significant decline (p<0.05) in carbohydrate content was reported by *Omeire et al.* 2014 on increased incorporation level of soya flour to WF.

Fruit and vegetable processing results into production of by-products, thus their utilization is important, economically and nutritionally (Vania *et al.* 2010). Moisture content of three noodle flavours was ranged between 57.6 and 59.2%. The sample (T_1) containing tomato, ginger and tangerine peel powders was the moistest among all whereas T_2 and T_3 had less moistened, respectively, attributed to low level of water in single ingredient. The protein content in T_1 was higher (4.4%) than T_3 and T_2 i.e. 2.4 and 2.0%, respectively. Vegetables and spices possess less amount of protein. A significant increase (p<0.05) was there in final product's protein content after value addition of pasta with tomato (Yadav *et al.* 2014). The crude fat content was ranged between 0.6 to 2.2%. Fat content was low in noodle flavours,

Table 5: Amino acid composition, Trypsin Inhibitor and *In vitro* protein digestibility of noodles and noodle flavours

Sample	Lysine (g/ 100 g protein)	Methionine (g/ 100 g protein)	Trypsin Inhibitor (mg/g)	*In vitro* protein digestibility
Noodles				
T_1	1.29±0.11[d]	1.03±0.01[a]	0.0±0.0	69.6±5.8[d]
T_2	3.56±0.06[a]	0.72±0.02[d]	2.72±**0.16**[a]	78±2.8[a]
T_3	2.31±0.09[b]	0.75±0.03[c]	2.32±**0.01**[c]	76.6±4.05[b]
T_4	1.92±0.08[c]	0.77±0.01[b]	1.70±**0.02**[b]	69.7±2.05[c]
Noodle flavours				
T_1	0.07±0.0	0.02±0.0	0.0±0.0	82.74±0.4[1]a
T_2	0.06±0.0	0.01±0.0	0.0±0.0	72.04±0.35[b]
T_3	0.06±0.0	0.01±0.0	0.0±0.0	70.22±0.76[c]

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

Where T_1 = 100 % Wheat Flour; T_2 = 60 % Defatted Soya Flour, 40 % Wheat Flour; T_3 = 50 % Defatted Soya Flour, 50 % Wheat Flour; T_4 = 40 % Defatted Soya Flour, 60 % Wheat Flour; Where, T_1 = Tomato (60 %) + Ginger (10 %) + Tangerine Peel Powder (10 %) + Turmeric (7.5 %) + Salt (10 %) + Black Pepper (2.5 %); T_2 = Tomato (60 %) + Ginger (20 %) + Turmeric (7.5 %) + Salt (10 %) + Black Pepper (2.5%); T_3 = Tomato (60 %) + Tangerine Peel Powder (20 %) + Turmeric (7.5 %) + Salt (10 %) + Black Pepper (2.5%)..

which may be due to very less amount of fat present in fruit and vegetable preparations. Highest fat content in T1 might be due to mixture of all three nutraceuticals i.e. tomato, ginger and tangerine peel powder, respectively. A significant (p<0.05) increase in crude fiber content was noted when combining all the nutraceutical ingredients together as in T_1 (4.6%) rather than excluding one of these in two other treatments (2.6 and 2.4% in T_2 and T_3), respectively. Artificial noodle flavours are generally lacking in fibre content. Approximately 4% increase in fiber at 10 and 15% incorporation level of tomato peel to durum wheat meal was reported (Padalino *et al.* 2017). Further, an increase of 0.2g in fiber content for per kg pasta was noted while 400g tomato puree was supplemented to 1kg of flour (Rekha *et al.* 2013). Results of our study were in accordance to the values observed by Mishra and Bhatt 2016. The mean ash content was almost double in T_1 (1.8%) as compared to 1.0% in T_2 and T_3, respectively. With regard to ash content of noodle flavours, close findings were reported by Mishra and Bhatt, 2016. An increase of 0.24% has been observed in ash content of tomato blended pasta as compared to wheat pasta by Yadav *et al.* 2014. The carbohydrate content ranged from 26.8 to 36.2%. Maximum amount of carbohydrate was reported in T2 and minimum in T1, respectively. Shere *et al.* (2018) observed a significant decline (p<0.05) in carbohydrate and fat content, however a significant increase (p<0.05) in fiber and ash content of wheat noodles when added with spinach puree up to 40% level.

Amino acid composition, Trypsin Inhibitor and *In vitro* protein digestibility

As the amino acid composition is concerned, the highest content of lysine was recorded in T_2 (3.56g/100g protein) (Table 5). The lowest lysine content (1.29g/100g protein) was observed in T_1. Control sample (T_1) has been reported with highest amount (1.03g/100g protein) of this amino acid as compared to three samples with assorted nutraceutical (0.72g/100g protein in T_2, 0.75g/100g protein in T_3 and 0.77g/100g protein in T_4) consisting of 60, 50 and 40% portion of DSF. Highest content of lysine was attributed to additional amount of DSF in T2. Similarly, more than double increase in lysine content of developed pasta from incorporation of DSF into sweet potato flour as compared to control sample was observed by Gopalakrishanan *et al.* 2011 during preparation of protein fortified pasta. Moreover, lysine content was increased by 1.34% in wheat soy flour spaghetti up to

50% incorporation level (Shogren *et al.* 2006). All the noodle samples were significantly ($p<0.05$) different in their methionine content. Since pulses contain lesser amount of methionine, and if the proportion of pulse flour to cereal flour is increased in composite flour mixture, the final product results into decreased methionine content. Mahmoud *et al.* 2012 too reported decreased methionine content in high quality protein noodles supplemented with lupine flour to WF. Two (T_2 and T_3) of the assorted nutraceutical noodle samples have shown more (2.72 and 2.32mg/g) amounts of trypsin inhibitor as compared to T_4 with only 1.70mg/g of this anti-nutritional factor. *In vitro* protein digestibility of noodles ranged between 69.6 to 78%. The outstanding digestibility percentages (78 and 76.6) were observed in T_2 and T_3 whereas T_1 and T_4 possessed almost same (69.6 and 69.7) percentage. Bhise *et al.* 2015 observed the highest (56.33%) protein digestibility in wheat soybean textured flour noodles (60: 40) on comparison with the incorporation of other ingredients i.e. sunflower (32.54%) and fenugreek (43.77%), respectively.

Lysine content was 0.07g/100g protein in T_1; 0.06 and 0.06g/100g protein in T_2 and T_3 noodle flavour samples, respectively. Methionine was present in negligible amounts (0.02, 0.01 and 0.01g/100g protein) in T_1, T_2 and T_3 treatments, respectively. Trypsin inhibitor was not present in any of the noodle flavour samples. With regard to *in vitro* protein digestibility of noodle flavours, T_1 has shown the highest (82.74%) *in vitro* protein digestibility when compared with T_2 and T_3 (72.04 and 70.22%), respectively.

CONCLUSION

It is summarized that nutritive value of noodles can be improved in terms of protein, fiber, ash content and amino acid composition, hence, through exercising assortment of nutraceuticals, ready to eat noodles and its flavours can be developed to enhance the micronutrient as well as antioxidant potential of this designer food.

REFERENCES

Abou-Arab, E.A., Mahmoud, M.H. and Abu-Salem, F.M. 2017. Functional properties of tangerine peel as affected by drying methods. *American J. Food Technol.*, **12**(3): 193-200.

Akeson, W.E. and Stachman, M.A. 1964. A pepsin-pancreatin digest index of protein quality evaluation. *J. Nutr.*, **83**: 257.

Amin, Y., Aggarwal, S., Islam, B. and Kumar, V. 2017. Preparation and quality analysis of fortified biscuits based on defatted soy flour and flax seed flour. *Inter. J. Chemi. Stud.*, **5**(6): 1666-1668.

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

AOAC, 2000. *Official Methods of Analysis.* Association of Official Analytical Chemist (17th Ed.) Washington, DC.

Ashwini, G.C., Kadam, V.S., Sakhare, R.S., Birajdar, G.O. and Nalwad, D.N. 2013. Role of nutraceuticals in various diseases: a comprehensive review. *Int. J. Res. Pharmacy and Chemistry*, 3(2): 290-299.

Ayele, H.H., Bultosa, G., Abera, T. and Astatkie, T. 2017. Nutritional and sensory quality of wheat bread supplemented with cassava and soybean flour. *Cogent. Food Agric.*, **3**(1).

Beniwal, P. and Jood, S. 2015. Development of low glycemic index noodles by legume and cereal by-products incorporation. *Inter. J. Health Sci. & Res.*, **5**(5): 381-387.

Bhise, S., Kaur, A. and Aggarwal, P. 2015. Development of protein enriched noodles using texturized defatted meal from sunflower, flaxseed and soybean. *J. Food Sci. Technol.*, **52**(9): 5882-5889.

Carpenter, K.J. 1960. The estimation of available lysine in animal protein foods. *Biochem. J.*, **77**: 604-610.

Chillo, S., Suriano, N., Lamacchia, C., Del Nobile, M.A. 2009. Effects of additives on the rheological and mechanical properties of non- conventional fresh handmade tagliatelle. *J. Cereal Sci.*, **49**: 163-170.

Ginting, E. and Yulifianti, R. 2015. Characteristics of noodle prepared from orange-fleshed sweet potato and domestic wheat flour. *Procedia Food Sci.*, **3**: 289-302.

Gopalakrishanan, J., Menon, R., Padmaja, G., Sanjeev, M.S. and Narayana Moorthy, S. 2011. Nutritional and functional characteristics of protein-fortified pasta from sweet potato. *Food Nutr. Sci.*, **2**: 944-955.

Gopalan, C., Rama Sastri, B.V. and Balasubramanian, S.C. 2004. *Nutritive Value of Indian Foods.* National Institute of Nutrition Press, Indian Council of Medical Research, Hyderabad (AP), India.

GraphPad Prism software. 2007. Version 5.01 for Windows. Dotmatics, San Diego, California (USA).

Horn, M.J., Jones, D.B. and Blum, A.E. 1946. Colorimetric determination of methionine in proteins and foods. *J. Biol. Chemist.*, **166**: 313-320.

Kanteti, V. 2015. Saga of "noodles doodles- An analysis of do's and don'ts during crisis communication with reference to Nestle India's magi noodles. *Int. J. Business Admin. Res. Rev.*, 2(11): 1-6.

Kowsalya, S., Ramalingam, S. and Ithayamalar, S. 2008. Impact of supplementation of food based anti-oxidant mix on the antioxidant status of selected breast cancer patients. *Ind. J. Nutr. Dietet.*, **45**: 257-263.

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. *Compre. Rev. Food Sci. Food Safety*, **13**(4): 347-357.

Mahmoud, E.A.M., Nassef, S.L. and Basuny, A.M.M. 2012. Production of high protein quality noodles using wheat flour fortified with different protein products from lupine. *Annals Agric. Sci.*, **57**(2): 105-112.

Mishra, P. and Bhatt, D.K. 2016. A study on development of fortified pasta with ginger powder. *IOSR J. Environ. Sci., Toxicol. Food Technol.*, **10**(8): 14-18.

Obafaye, R.O. and Omoba, O.S. 2018. Orange peel flour: A potential source of antioxidant and dietary fiber in pearl millet biscuits. *J. Food Biochem.*, **42**(4): http://doi.org/10.1111/jfbc.12523.

Omeire, G.C., Umeji, O.F. and Obasi, N.E. 2014. Acceptability of noodles produced from blends of wheat, acha and soybean composite flours. *Nigerian Food J.*, **32**(1): 31-37.

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. *Journal of Food Processing and Technology*, **7**(10).

Rababah, T.M., Al-Mahasneh, M.A. and Ereifej, K.I. 2006. Effect of chickpea, broad bean or isolated soya protein (ISP) additions on the physicochemical and sensory properties of biscuits. *J. Food Sci.*, **71**: 438-442.

Rai, S.K., Arora, N., Pandey, N., Meena, R.P., Shah, K. and Pandey-Rai, S. 2012. Nutraceutical enriched vegetables: molecular approaches for crop improvement. *Int. J. Pharma Biosci.*, **3**(2): B363- B379.

Reddy, C.K., Haripriya, S. and Vidya, P. 2015. Morphology, physicochemical and functional characteristics of starches from different banana cultivars. *J. Food Sci. Technol.*, **52**(11): 7289-7296.

Rekha, M.N., Chauhan, A.S., Prabhashankaer, P., Ramteke, R.S. and Venkateswara Rao, G. 2013. Influence of vegetable paste on quality attributes of pastas made from bread wheat (*T. aestivum*). *CyTA J. Food*, **11**: 142-149.

Saharan, V. and Jood, S. 2017. Quality characteristics of noodles enriched with *Spirulina platensis* powder. *Inter. J. Agri. Sci.*, **9**(14): 4091-4094.

Sapkale, A.P., Thorat, M.S., Vir, P.R. and Singh, M.C. 2012. Nutraceuticals- Global status and applications: a review. *Int. J. Pharma. Chem. Sci.*, **1**(3): 1166-1181.

Saxena, R. 2015. Defeating cancer with healthy nutrition. Sci. Report, pp. 14-19.

Shah, N.A. and Jetwat, J.S.H. 2012. Study of consumers' preferences & its affecting factors towards selection of various noodles of branded companies in Ahmedabad City. *ELK Asia Pacific J. Market Retail Manage*, **3**(1): 70-76.

Shere, P.D., Devkatte, A.N. and Pawar, V.N. 2018. Studies on production of functional noodles with incorporation of spinach puree. *Int. J. Curr. Microbiol. Appl. Sci.*, **7**(6): 1618-1628.

Shogren, R.L., Hareland, G.A. and Wu, Y.V. 2006. Sensory evaluation and composition of spaghetti fortified with soy flour. *J. Food Sci.*, **71**(6): S428-S432.

Sunil, Chauhan, N., Chaudhary, V., Singh, K., Kumar, V. and Singh, B. 2019. Study on sensory evaluation of multi flour noodles during storage. *Int. J. Pure & Appl. Biosci.*, **7**(1): 383-388.

Suriya, M., Rajput, R., Reddy, C.K., Haripriya, S. and Bashir, M. 2017. Functional and physicochemical characteristics of cookies prepared from *Amorphophallus paeoniifolius* flour. *J. Food Sci. Technol.*, **54**(7): 2156-2165.

Swami, S., Krishnan, A.V., Moreno, J., Bhatacharyya, R.B., 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.*, 205S-210S.

United States Department of Agriculture 2018. USDA Food Composition databases. Report of a USDA expert committee. USDA.gov.

Vania, U.O., Agustin, R.C., Jaime, L.M., Elizabeth, C.M., Alfonso, A.G. and Benjamin, R.W. 2010. A novel pectin material: extraction, characterization and gelling properties. *Int. J. Mol. Sci.*, **11**: 3686-3695.

World Instant Noodles Association 2015. Global demand. http://instantnoodles.org/en/noodles/market.html.

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.

Zhang, J., Dhakal, I.B., Zhao, Z. and Li, L. 2012. Trends in mortality from cancers of breast, colon, prostate, oesophagus and stomach in East Asia: role of nutrition transition. *Euro. J. Can. Preven.*, **21**: 480- 489.