



Estimation of Multi Millet Convenience Products (Noodles, Pasta and Vermicelli) Proximate Composition

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ABSTRACT

Background: Due to rapid urbanization and increasing segment of working women, convenience products such as ready-to-eat and ready-to-use are gaining popularity. Millets are unique among the cereals due to rich content of calcium, dietary fiber; polyphenol and protein content majorly amino acids like methionine, cysteine, and are contributing to national food security due to their potential health benefits. Millet grain is now receiving increasing interest from food scientists, technologists and nutritionists.

Methods: Multi millet convenience products was developed with proportions of multi millet and refined flour using extrusion technology and the present study was designed to analyze the proximate composition such as moisture, protein, fat, ash, carbohydrate and energy content of the developed multi millet convenience products.

Result: Among the developed proportion 60: 40 proportion noodles was labelled as (MMNF1), 25:75 pasta as (MMPF3) and 50:50 vermicelli as (MMVF1). The results showed that the proximate composition (ash, fat and protein) of multi millet convenience products (noodles- 4.23 ± 0.08 , 0.98 ± 0.11 , 10.82 ± 0.09 ; pasta- 4.93 ± 0.08 , 1.00 ± 0.05 , 11.79 ± 0.03 and vermicelli- 3.80 ± 0.23 , 1.26 ± 0.08 , 11.16 ± 0.21) was high compared to control. In contrast, the moisture, carbohydrate and energy content was low in (MMNF1- 8.66 ± 0.13 , 73.54 ± 0.14 , 346.2 ± 1.1 ; MMPF3- 8.80 ± 0.10 , 71.60 ± 0.09 , 342.5 ± 0.3 and MMVF1- 8.36 ± 0.12 , 73.83 ± 0.42 , 351.5 ± 1.0) than control.

Key words: Carbohydrate, Convenience, Multi millet, Noodles, Pasta, Protein, Proximate, Vermicelli.

INTRODUCTION

Increase in urbanization, westernization and mechanization in countries had led to a sedentary lifestyle and a diet having high energy foods patterns are contributing to several chronic degenerative diseases. Hypoglycemic effect of minor millets (*viz.*, foxtail millet, little millet, kodo millet, proso millet and finger millet) with their high crude fibre, antioxidant, low carbohydrate content, low digestibility and presence of β -glucans which are water soluble gums is helpful in repairing glucose metabolism and related diseases (Subbulakshmi and Malathi, 2020).

Millets had great potential for being utilized in different food systems by virtue of their nutritional quality and economic importance. There is a wide scope of their exploitation in different food products including bakery products, instant mixes and convenience food mixes (Subbulakshmi and Karpagavalli, 2017).

The demand for frozen, fast, ready to cook and ready to eat food is steadily increasing, especially in metropolitan cities of the India. About one-third of the India's food industry comprises of processed foods (Vijayabaskar and Sundaram, 2012). Most of the convenience foods in India are cereal-based snacks, categorized under junk foods due to lower protein and higher content of fat, sugar and salt (Bucher *et al.*, 2016).

Value addition of products with improved health benefits by combining millets with traditional cereals with application of advanced technologies for processing and preservation opens new opportunities for the product diversification (Sudha *et al.*, 2016).

Extrusion is an energy-efficient, high temperature short time (HTST) technique process with a range of food

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applications. Grain extrusion processing causes a variety of chemical and physical changes such as starch gelatinization, protein denaturation, enzyme inactivation, microbial and anti-nutritional reductions (Pathania *et al.*, 2013).

Hence, there is a need to develop these convenience products by incorporating millet flours. Therefore, the present study was conducted on proximate composition of multi millet *i.e.*, (proso millet, kodo millet and barnyard millet) convenience products such as noodles, pasta and vermicelli using extrusion technology.

MATERIALS AND METHODS

The present study on "Estimation of multi millet convenience products (noodles, pasta and vermicelli) proximate composition" was conducted using the glassware and

equipment of the department of Foods and Nutrition, Post Graduate and Research Center, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad. Dehulled millet flours (proso, kodo and barnyard) were purchased from millet dealers and other ingredients used for the study were obtained from local markets. All the chemicals used in the investigation were of Food and Analytical Reagent (AR) grade.

In the present study, minor millets (proso, kodo, barnyard) with different proportions were used for development of multi millet convenience products (noodles, pasta and vermicelli). Guar gum a hydrocolloid was used in the study as the grains are gluten free. Multi millet convenience vermicelli formulations were developed by extruding through die of diameter (1 mm). Multi millet convenience noodles were developed by extruding the dough through die of diameter (1.5 mm) and convenience pasta was extruded from the die of diameter (5 mm) in a cold extruder (La Monferrina Pasta making machine, Agaram Industries, Hyderabad). The developed products were tray dried in tray drier (Thermo control systems, Hyderabad) at 60°C to attain moisture content below 10% (Nilusha *et al.*, 2019) and the developed products were sensorially evaluated by 15 semi trained panel members using 9 point hedonic scale.

Proximate analysis of multi millet convenience products (MMNF1, MMPF3 and MMVF1)

The sensorially accepted multi millet convenience products (noodles- MMNF1, pasta- MMPF3 and vermicelli- MMVF1) along with control (CN, CP and CV) was subjected for estimation of proximate composition.

Estimation of moisture

Principle

Moisture and water content are among the most important parameters measured in food as moisture content is inversely related to the dry matter of a food item that has direct economic effect on consumers and processors. More importantly, the moisture content in food also influences its storage stability and quality. Moisture content of the given samples was estimated as per AOAC (2005) method.

Estimation of ash

Principle

Foods and its products are heated to temperatures of 550 - 600°C where the water and other volatile constituents evolve as vapors. The organic constituents were burned in the presence of oxygen to carbon dioxide and oxides of nitrogen eliminated together with hydrogen as water. The mineral constituents remain in the residue as oxides, sulphates, phosphates and chlorides and this inorganic residue constitutes the ash in food products (AOAC, 2005).

Estimation of protein

The crude protein content of the sample was estimated according to the Micro kjeldhal method AOAC (2005),

calculated as percent nitrogen of product and multiplied with 6.25 to obtain the protein content.

Estimation of fat

Fat was estimated as crude ether extract of the dry material using automatic Soxtherm extraction unit (AOAC, 1997).

Computation of carbohydrate

Carbohydrate content was computed by subtracting the total of moisture, protein, fat, ash and crude fiber from 100 (AOAC, 1980).

Computation of energy

Energy content was computed by multiplying protein, fat and carbohydrate values obtained from analysis by 4, 9 and 4 respectively and expressed as Kcal / 100 g (AOAC, 1980).

RESULTS AND DISCUSSION

Carbohydrates are hydrolyzed in the body to yield glucose which can be utilized immediately, or stored as glycogen in the muscles and liver. Proteins are important in the body for the production of hormones, enzymes and blood plasma. They are immune boosters and can help in cell division well as growth (Okeke *et al.*, 2008).

Fats are secondary plant products that yield more energy per gram than carbohydrates. Dietary fats are important not only because of their high energy value but the fat-soluble vitamins and essential fatty acids of natural foods. Fats and oils help to regulate blood by pressure and play useful role in the synthesis and repair of vital cell parts (Ilodibia *et al.*, 2015).

Proximate composition such as moisture, ash, fat, protein, carbohydrate and energy content of the multi millet convenience products like noodles (MMNF1) and vermicelli (MMVF1) along with control was analyzed and presented in Table 1 and 2.

Proximate composition of multi millet convenience noodles

Moisture

The proximate composition of convenience noodles given in Table 1 showed that the results of MMNF1 moisture content had significant difference ($p < 0.05$) compared to control. Moisture content of MMNF1 (8.66 ± 0.13) was low compared to control noodles CN (10.23 ± 0.03).

Himabindu and Devanna, (2015) developed nutrient rich noodles prepared by the addition of 30% proportion of wheat and 70% malted kodo millet flour had moisture content of (5.07%).

Vijayakumar *et al.* (2010) prepared noodles with 20% composite flour of millet flour blend (kodo and barnyard), whole wheat flour and soy flour that had moisture content of (10.7%).

Ash

F1 (4.23 ± 0.08) was highest compared to control noodles CN (2.56 ± 0.12). The increase in ash content of multi millet noodles might be due to the millet incorporation.

Table 1: Proximate composition of multi millet convenience noodles.

Sample	Moisture (g/100 g)	Ash (g/100 g)	Fat (g/100 g)	Protein (g/100)	Carbohydrate (g/100 g)	Energy (kcal/100 g)
CN	10.23 ^a ±0.03	2.56 ^b ±0.12	0.56 ^b ±0.12	9.30 ^b ±0.11	76.83 ^a ±0.26	351.6 ^a ±0.4
MMNF1	8.66 ^b ±0.13	4.23 ^a ±0.08	0.98 ^a ±0.11	10.82 ^a ±0.09	73.54 ^b ±0.14	346.2 ^b ±1.1
Mean and SE	9.44±0.35	4.02±0.73	1.08±0.24	9.62±0.10	75.64±0.54	348.91±0.75
CD	0.51	0.79	0.14	0.89	0.61	2.94
CV (%)	1.55	2.78	3.76	2.65	0.23	0.23

Note: Values are expressed as mean ± standard deviation for the two determinants.

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

CN: Control noodles. MMNF1: Proso, kodo and barnyard millet (1:1:1) incorporated noodles

Table 2: Proximate composition of multi millet convenience vermicelli.

Sample	Moisture (g/100 g)	Ash (g/100 g)	Fat (g/100 g)	Protein (g/100)	Carbohydrate (g/100 g)	Energy (kcal/ 100 g)
CV	9.46 ^a ±0.06	2.30 ^a ±0.15	0.71 ^b ±0.14	10.31 ^a ±0.04	75.81 ^a ±0.24	354.9 ^a ±1.0
MMVF1	8.36 ^b ±0.12	3.80 ^a ±0.23	1.26 ^a ±0.08	11.16 ^a ±0.21	73.83 ^a ±0.42	351.5 ^b ±1.0
Mean and SE	8.91±0.15	4.05±0.61	1.23±0.24	11.23±0.10	75.02±0.60	353.22±1.07
CD	0.74	1.55	0.54	1.03	2.31	1.15
CV (%)	2.37	1.90	2.46	2.61	0.88	0.67

Note: Values are expressed as mean ± standard deviation for the two determinants.

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

CV: Control vermicelli, MMVF1: Proso, kodo and barnyard millet (1:1:1) incorporated vermicelli

Noodles prepared with ragi and wheat flour in proportions (10:90; 20:80; 30:70; 40:60) had an ash content ranged from 1.16-1.49. The ash content was increased with increase in ragi flour was reported by Kudake *et al.* (2018).

The results of ash content of MMNF1 was similar to the results of noodles prepared with incorporation of 70% malted kodo millet flour 4.29% was reported by Himabindu and Devanna, (2015).

Protein

Multi millet noodles and control noodles had significant difference ($p < 0.05$) with respect to protein content and the results showed that MMNF1 (10.82±0.09) had high protein compared to control (CN -9.30±0.11).

The protein content of 10%, 20% and 30% incorporation of daber (*Sorghum bicolor*) and other ingredients like wheat flour, guar, edible oil for preparation of noodles had protein content of 6.5%, 12.0% and 17.5% in millet-noodle was reported by Siddeeg *et al.* (2018).

The protein content of noodles prepared by supplementation of wheat flour with ragi flour (0-40%) had ranged from 9.11±0.27 to 11.35±0.29, with increase in millet proportion significant increase in protein was reported by Kudake *et al.* (2018).

Fat

Fat content had significant ($p < 0.05$) difference in between MMNF1 and control, the multi millet convenience noodles had high fat content (0.98±0.11) than control (CN-0.56±0.12).

The fat content of the nutrient rich noodles prepared with supplementation of malted ragi flour (70:30) and other ingredients like vegetable oil, corn flour, wheat gluten and guar gum had the fat content of 15.6% might be due to the addition of vegetable oil (Kulkarni *et al.*, 2012).

The fat content of multi millet noodles prepared with refined wheat flour, millets flour (*i.e.*, sorghum, bajra, foxtail flour), sweet potato flour in different proportions (T1-60:30:05, T2- 55:30:10, T3-50:30:15) had fat content of (2.78±0.072, 2.39±0.006, 1.82±0.017) which was reported by (Mathila *et al.*, 2021).

Carbohydrate

The carbohydrate content of control noodles (CN- 76.83±0.26) was highest compared to multi millet convenience noodles (73.54±0.14) and the samples had significant difference ($p < 0.05$) of carbohydrate content.

The carbohydrate content of the noodles prepared with the incorporation of 40% ragi flour had 62.03±0.39 (Kudake *et al.*, 2018).

The noodles prepared with 10%, 20% and 30% of millets (Sorghum and wheat noodles) had carbohydrate content of 75.14%, 74.32% and 70.26% in millet-noodle was reported by (Almahi, 2018).

Energy

The energy values of multi millet convenience products was calculated using the Atwater factor of 4, 9 and 4 kcal/g for protein, fat and carbohydrate, respectively.

The energy values had significant ($p < 0.05$) difference and the control noodles (351.6 ± 0.4) had highest energy values compared to multi millet convenience noodles ($MMNF1-346.2 \pm 1.1$) Kcal/100g.

The energy content of noodles prepared with 70:30 (wheat and malted kodo millet flour) composition had 384.1 Kcal was reported by (Himabindu and Devanna, 2015).

Proximate composition of multi millet convenience pasta

The percentage change of multi millet convenience pasta proximate composition was given in Fig 1.

The proximate composition of multi millet convenience pasta had significant ($p < 0.05$) difference compared to control pasta. The moisture and energy content of multi millet convenience pasta was decreased by 2%. Whereas the ash, protein, fat and carbohydrate content was increased by 52.6%, 17.6%, 25%, 5% content compared to control pasta.

Moisture and ash

MMPF3 moisture (8.80 ± 0.10) was low compared to control pasta CP (9.10 ± 0.02) and multi millet pasta had 3% decreased in moisture compared to control. The ash content had significant difference ($p < 0.05$) between multi millet incorporated and control pasta and MMPF3 had (4.93 ± 0.08) high ash content compared to control pasta CP (3.23 ± 0.14) and ash content of noodles developed with multi millet flour was increased by 52.6%.

The cold extruded products (vermicelli and pasta) with incorporation of 50% each millet flour (barnyard, kodo, foxtail, proso and little) of which barnyard pasta had (8.85%), kodo (8.36) and proso pasta had moisture content of 8.26% and the pasta with barnyard had ash content of (2.05), proso (1.98) and kodo (1.71) was reported by (Ranganna *et al.* 2014).

The moisture content of ready-to-cook pasta with foxtail millet and tapioca flour in proportions T1 (50:45), T2 (60:40), T3 (70:30) and T4 (60:40) had 8.813 ± 0.033 , 8.850 ± 0.020 , 8.900 ± 0.028 and 8.925 ± 0.054 was reported by (Dhas *et al.*, 2021).

The ash content of cookies prepared with multi millet flour (wheat flour, kodo, little, foxtail and finger millet flour at each 20 per cent level) had 0.84% and control cookie had an ash content of 1.00% (Subbulakshmi and Malathi, 2017).

Protein and fat

The pasta developed had significant difference ($p < 0.05$) of protein content and had no significant difference of fat content compared to control pasta. The multi millet convenience pasta protein (11.79 ± 0.03) and fat (1.00 ± 0.05) was high compared to the control pasta (10.02 ± 0.07 , 0.80 ± 0.05) and multi millet pasta had 17.6% increased protein and 25% fat compared to the control.

The protein content of pasta formulated with 100% wheat flour had 10.07% and pasta with incorporation of (foxtail millet: Green gram: wheat) in proportions 30:10:60 had (13.07), 40:10:50 (12.98), 50:10:40 (12.89) and 60:10:30 (12.8) and fat content of (1.6 ± 0.33 , 1.38 ± 0.85 , 1.16 ± 0.52 and 0.94 ± 0.37) was reported by (Bhuvaneswari and Nazni, 2020).

The fat content of the pasta prepared by incorporating the foxtail millet and tapioca in proportions *i.e.* 55:45 had (1.429 ± 0.028), 60:40 (1.856 ± 0.029); 70:30 (1.917 ± 0.028) and 80:20 had fat composition of (2.063 ± 0.053) was reported by (Dhas *et al.* 2021).

Carbohydrate and energy

The accepted multi millet convenience pasta had significant difference ($p < 0.05$) compared to control pasta that had high carbohydrate and energy content (75.50 ± 0.19 , 349.6 ± 0.8) compared to MMPF3 (71.60 ± 0.09 , 342.5 ± 0.3). Multi millet pasta carbohydrate and energy content was decreased by 5% and 2% compared to control.

The carbohydrate content of the pasta prepared with combinations of foxtail millet and tapioca (55:45, 60:40, 70:30 and 80:20) had (77.759 ± 0.116 , 76.165 ± 0.055 , 75.014 ± 0.072 and 73.654 ± 0.179) was reported by (Dhas *et al.*, 2021). Similar carbohydrate content was observed in the study.

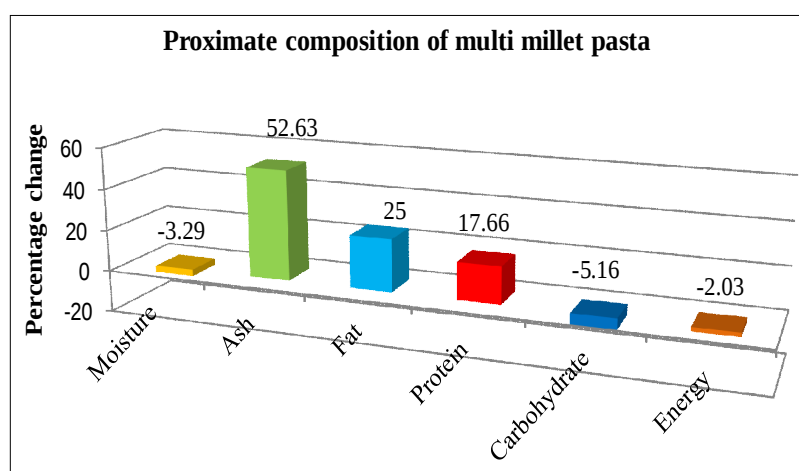


Fig 1: Percentage change in proximate composition of multi millet convenience pasta.

The carbohydrate content of the millet pasta prepared with blend of 20 g Finger millet flour and 12 g pearl millet flour/ 100 g to composite flour (64 g durum wheat semolina, 4 g carrot pomace) had 70.84% was reported by (Gull *et al.*, 2018).

The energy content pasta prepared by composition of 30:10:60 (foxtail millet: Green gram: wheat) had 344.7±1.89 was reported by (Bhuvaneswari and Nazni, 2020).

Proximate composition of multi millet convenience vermicelli

Moisture

The mean scores of proximate composition given in Table 2 showed that the moisture content of 50% multi millet incorporated vermicelli (8.36±0.12) was less compared to control (9.46±0.06).

The vermicelli prepared using barnyard millet flour (BMF) and rice flour (RF) along with whole green gram malt flour, carrot powder, fenugreek powder and xanthan gum (XG) had moisture content of 6.4% was reported by (Goel *et al.* 2021).

The ekanayakam root powder incorporated barnyard millet vermicelli contains moisture % of 7.78 was reported by (Chandraprabha *et al.* 2017).

Ash and protein

The ash and protein content of MMVF1 (3.80±0.23, 11.16±0.21) was high compared to control (2.30±0.15, 10.31±0.04) with statistically no significant difference ($p < 0.05$) between the ash content and had significant difference with respect to protein content.

The ash content of vermicelli prepared with wheat flour, soy flour and barnyard millet was (2.05%) and that of the control vermicelli was (0.57%), might be due to high minerals content of barnyard millet was reported by Ranganna *et al.*, (2014).

The vermicelli prepared with wheat sooji and malted finger millet flour mixed in different proportions such as 100:0 (To), 90:10 (T1), 80:20 (T2), 70:30 (T3), 60:40 (T4) and 50:50 (T5) had (2.80, 2.90, 3.00, 3.11, 3.20, 3.31%) and the T5 (50:50) composition had 8.88% protein content. Ash content showed a positive relation with levels of malted finger millet flour was reported by (Lande *et al.*, 2017).

The protein content of the vermicelli prepared with incorporation of wheat semolina (80%), finger millet (20%) and guar gum (2%) was 10.39 as reported by (Swami *et al.*, 2021).

Fat, Carbohydrate and Energy

The multi millet vermicelli with 50% incorporation had carbohydrate and energy content (73.83±0.42, 351.5±1.0) less compared to the control vermicelli (CV- 75.81±0.24, 354.9±1.0). In contrast, MMVF1 (1.26±0.08) fat content was high than control (0.71±0.14).

The fat content of the vermicelli prepared with 40% barnyard millet flour, 58% whole wheat flour and 2% Ekanayakam root bark powder had 1.91% fat content,

energy content of (263.44Kcal/ 100g) was reported by (Chandraprabha *et al.*, 2017).

The fat content of vermicelli prepared with refined wheat flour, barnyard millet and defatted soy flour in proportion (45:45:10) had 2.58% was reported by (Agarwal *et al.*, 2013).

CONCLUSION

India is a leading producer of small millet viz., foxtail millet, little millet, kodo millet, proso millet and finger millet. The cultivation of millet is more in Madhya Pradesh, Chattisgarh, Orissa, Tamil Nadu, Jharkhand, Karnataka, Andhra Pradesh and Maharashtra. The hypoglycemic effect of minor millets with their high crude fibre, antioxidant, low carbohydrate content, low digestibility and presence of β -glucans which are water soluble gums is helpful in repairing glucose metabolism. This type of dietary consumption would be a significant way to increase the low carbohydrate and low energy foods. Processing and utilization of millets in product development have promising prospects with regard to nutrition, quality and health benefits and can be an alternative to cereals.

Conflict of interest

There is no conflict of interest between the authors in publishing this article.

REFERENCES

- Agarwal, D., Upadhyay, A., Nayak, P.S. (2013). Feasibility and acceptability of fortified vermicelli prepared from barnyard millet and defatted soy flour. *Asian Journal of Home Science*. 8(2): 461-464.
- Almahi, R.A.Y. (2018). Production of noodles from wheat flour mixed with sorghum and millet and their nutritional and sensory characteristics, University of Gezira. pp 1-64.
- AOAC, (1980). Official methods of analysis. Association of Official Analytical Chemists, Washington, D.C. USA.
- AOAC, (1997). Official Methods of Analysis for fat (crude) or ether extract in flour. Association of Official Analytical Chemists. 16th Ed. 3rd Revision. Gaithersburg, Maryland 20877-2417.
- AOAC, (2005). Official Methods of Analysis for ash in flour. Association of Official Analytical Chemists. 18th Ed. Arlington VA 2209.
- AOAC, (2005). Official Methods of Analysis for Moisture in Flour. Association of Official Analytical Chemists. 18th Ed. Arlington VA 2209.
- AOAC. 2005. Official Methods of Analysis for protein. Association of Official Analytical Chemists. 18th Ed. Arlington VA 2209.
- Bhuvaneswari, R., Nazni, P. (2020). Formulation and quality characterization of foxtail millet and green gram incorporated pasta, *Adalya Journal*. 9(1): 1041-1053.
- Bucher, T., Collins, C., Diem, S., Siegrist, M. (2016). Adolescents perception of the healthiness of snacks. *Food Quality and Preference*. 50: 94-101.
- Chandraprabha, S., Sharon, C.L., Panjikaran, S.T., Aneena, E.R., Beena, C. (2017). Development and nutritional qualities of vermicelli prepared from barnyard millet and Ekanayakam root bark, *Journal of Pharmacognosy and Phytochemistry*. 6(6): 2359-2362.

- Dhas, T.A., Rao, V.A., Sharon, M.E.M., Manoharan, A.P., Nithyalakshmi, V. (2021). Development of fibre enriched ready-to-cook pasta with foxtail millet and tapioca flour. *The Pharma Innovation Journal*. 10(5): 1432-1435.
- Goel, K., Goomer, S., Aggarwal, D. (2021). Formulation and optimization of value-added barnyard millet vermicelli using response surface methodology, *Asian Journal of Dairy and Food Research*. pp. 1-7.
- Gull, A., Prasad, K., Kumar, P. (2018). Nutritional, antioxidant, microstructural and pasting properties of functional pasta, *Journal of the Saudi Society of Agricultural Sciences*. 17(2): 147-153.
- Himabindu, P., Devanna, N. (2015). Development of nutrient rich noodles by supplementation with malted kodo millet flour, *International Journal of Advancements in Research and Technology*. 4(12): 7-16.
- Ilodibia, C.V., Ugwoke, C.E., Egboka, T.P., Akachukwu, E.E., Chukwuma, U.M., Aziagba, B.O. (2015). Breeding pepper for enhanced food nutrients. *Asian J. Crop Sci*. 7: 214-218.
- Kudake, D.C., Bhalerao, P.P., Chaudhari, N.S., Muley, A.B., Talib, M.I., Parate, V.R. (2018). Fortification of wheat flour with ragi flour: Effect on physical, nutritional, antioxidant and sensory profile of noodles. *Current Research in Nutrition and Food Science*. 6(1): 165-173.
- Kulkarni, S.S., Desai, A.D., Ranveer, R.C., Sahoo, A.K. (2012). Development of nutrient rich noodles supplemented with malted ragi flour. *International Food Research Journal*. 19(1): 309-313.
- Lande, S.B., Thorats, S. and Kulthe, A.A. (2017). Production of nutrient rich vermicelli with malted finger millet (Ragi) flour. *International Journal of Current Microbiology and Applied Sciences*. 6(4): 702-710.
- Mithila, A., Sowjanya, K., Seelam, B.S., Akhila, M., Madhuri, J.S. (2021). Fiber enriched multi-millet noodles-incorporated with sweet potato flour. *The Pharma Innovation Journal*. 10(10): 1064-1068.
- Nilusha, R.A.T., Jayasinghe, J.M.J.K., Perera, O.D.A.N., Perera, P.I.P. (2019). Development of pasta products with nonconventional ingredients and their effect on selected quality characteristics: A brief overview. *International Journal of Food Science*. 1-10.
- Okeke, C.U., Izundu, A.I., Uzoechinda, E. (2008). Phytochemical and proximate study of female pawpaw (*Carica papaya* L.). *Caricaeae. J. Sci. Eng. Technol*. 1: 8207-8216.
- Pathania, S., Singh, B., Sharma, S., Sharma, V., Singla, S. (2013). Optimization of extrusion processing conditions for preparation of an instant grain base for use in weaning foods, *International Journal of Engineering Research and Applications*. 3(3): 1040-1049.
- Ranganna, B., Ramya, K.G., Kalpana, B., Veena, R. (2014). Development of cold extruded products (vermicelli and pasta). *International Journal of Agricultural Engineering*. 7(2): 360-364.
- Siddeeg, A., Salih, Z.A., Ammar, A., Almahi, R.A.Y., Ali, A.O. (2018). Production of noodles from composite flour and its nutritional and sensory characteristics. *Chinese Journal of Medical Research*. 1(1): 03-07.
- Subbulakshmi, B., Karpagavalli, B. (2017). Standardization and evaluation of high fibre convenient food from oats flour. *Journal of Innovative Agriculture*. 4: 26-31.
- Subbulakshmi, B., Malathi, D. (2017). Formulation of multi millet cookies and evaluate its hypoglycaemic effect in albino rats. *J. Crop Weed*. 13(3): 112-116.
- Sudha, A., Devi, K.S.P., Sangeetha, V., Sangeetha, A. (2016). Development of Fermented Millet Sprout Milk Beverage based on Physicochemical Property Studies and Consumer Acceptability Data. *Journal of Scientific and Industrial Research*. 75: 239-243.
- Swami, A.M., Sadawate, S.K., Patil, B.M., Sawate, A.R., Kshirsagar, R.B., Wandhekar, S.S. (2021). Studies on preparation of finger millet vermicelli and effect of guar gum on chemical and sensory characteristics. *Biological Forum - An International Journal*. 13(1): 679-683.
- Vijayabaskar, M., Sundaram, N. (2012). A study on purchasing attitude towards Ready-to-eat/cook products by health conscious consumers in Southern India with respect to Tier-I cities, *International Journal of Physical and Social Sciences*. 2(4): 417-436.
- Vijayakumar, T.P., Mohankumar, J.B., Srinivasan, T. (2010). Quality evaluation of noodles from millet flour blend incorporated composite flour. *Electronic Journal of Environmental, Agricultural and Food Chemistry*. 69(1): 48-54.