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DEVELOPMENT AND QUALITY EVALUATION OF NOODLES FROM PEARL MILLET FERMENTED FLOUR

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Abstract

This study presents influence of millet flour blend on chemical, functional, nutritional quality and sensory evaluation of noodles prepared from pearl millet flour and fermented flour. In the present investigation development of nutrient rich noodles through fermentation at different time (24 hrs, 48 hrs, 72 hrs). Fermented noodles at 72 hours of fermentation got good results as compare to nonfermented noodles. Results revealed that among all the fermented noodles 72 hours noodle got good result in both the varieties. In fermented noodles moisture, protein content, fat and fibre content increased with increase in fermentation time and carbohydrate decreases with increase in fermentation time. overall sensory evaluation of developed noodle and fermented noodles flour was in the range of highly acceptable at 72 hrs of fermentation.

KEY WORDS: Pearl millet, fermentation, Noodles, Sensory

Introduction

Noodles are consumed worldwide. Instant noodles are widely consumed worldwide and are a rapidly growing sector of the noodle industry (Owen, 2001). Noodles have a long shelf life and instant noodles are also convenient, easy to prepare and low cost. The addition of basic salts can help strengthen the structure and thus improve the strength of the final product. This is because instant noodles become suitable, prepared easily, inexpensive and also have long shelf life. Noodles have a long shelf life and instant noodles are also convenient, easy to prepare and low priced. Addition of basic salts can help strengthen the structure of the final product and thus improve strength (Hou and Kruk, 1998). Noodles can also be made from rice, buckwheat and starchy potatoes, sweet potatoes and legumes. Maize starch can be used as a binder in noodles (Basmani *et al*., 2008). To slightly reduce hardness and cohesion, GMS could significantly increase gumminess, flexibility and chewiness. (Kaur *et al*., 2005). During cooking of noodles and steaming it partially the flavour and texture of noodles get improved. (Kim, 1996). Noodles recognized internationally as it is consumed in farther 80 countries throughout the World because demand is high. Noodle industry supplies 95.4 billion servings annually to consumers.

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According to the instant noodle association. Worldwide, China ranks first to the intake of noodles observed with the aid of using Indonesia, Japan, and Vietnam. Although intake of noodles in India have been low. Development of acceptable food products noodles there is tremendous opportunity to develop functional food targeted for those at risk for diabetes. The millet grains offer many opportunities for utilization in diversified products.

Materials and Method

Pearl millet flour + Guar gum (1%)

⇩

Dough preparation

⇩

Making of noodles by using Extruder

⇩

Drying (72°C 3 hrs)

⇩

Prepared noodles

⇩

Packaging

Fig. 3.3 Flow chart for preparation of noodles using extruder

Physico chemical analysis

2.2.1 Moisture content determined by AOAC, (2000) method

Here instrument used to determine humidity is a hot air oven. Approximately 5 g of the prepared sample, previously air-dried and weighed in an oven, is weighed into a dish, the dish is kept in an oven that is kept at 120 °C for 1 hour. was cooled in a desiccator and the wt. Repeat drying, cooling and weighing every 30 minutes until two consecutive weights are less than 1 minute apart. record the lowest weight.

$$\text{Moisture Content \%} = \frac{W1 - W2}{W1} \times 100$$

Where,

W1 – sample weight before drying in (g)

W2 - sample weight after drying in (g)

ISSN PRINT 2319 1775 Online 2320 7876

 Journal Volume 13, Iss 02, 2024

2.2.2 Protein content determined by kjeldahl method.

The Micro kjeldahl method described by **AOAC, (2000)** was used to determine the crude protein. 2g of each of the pearl millet flour was mixed with 10ml of concentrated H_2SO_4 in a heating tube. 2-3g of catalyst mixture was added to the tube and mixture heated. The digest was transferred into distilled water. 10 ml portion of the digest mixed with equal volume of 40% NaOH solution and poured into a micro kjeldahl distillation apparatus. The mixture is distilled and the distillate collected into 2% boric acid solution containing Bromocresol green and methyl red indicator in ratio of 1:5. A total of 50ml distillate was collected and titrated as well. The sample was duplicated and the average value taken. The Nitrogen content was calculated and multiplied with 6.25 to obtain the crude protein content.

$$\textbf{Nitrogen (\%)} = 14 \times \textbf{N of HCL} \times \frac{\textbf{Titrate value} \times \textbf{dilution factor}}{\textbf{weight of sample}} \times 100$$

$$\textbf{Protein (\%)} = \textbf{Nitrogen (\%)} \times 6.25$$

Where

N= Normality of the titrate (0.1N)

2.2.3 Crude Fat Soxhlet method used to determine Fat 5 gm of sample was weighed and placed in an oven for one hour. Dried sample after moisture determination was then transferred to thimble and then the top of the thimble was plugged with cotton. This thimble is then dropped into the fat extraction soxhlet apparatus tube attached to soxhlet flask. Petroleum ether (about 75ml or more) was then poured through the sample in the tube into flask. Then condenser was attached to the fat extraction tube. Extraction was carried out for 6-8 hours or longer. At the end of extraction, thimble was removed from the apparatus and the flask was heated from some time so that ether present in extracted fat gets evaporated. It was then cooled for some time and then the fat containing flask was weighed. Crude fat can be calculated using formula. **Ranganna, (2004)**

$$\%\ Crude\ Fat = Final\ weight\ (gm) - Initial\ Weight\ (gm)\ Sample\ Weight\ (gm) \times 100$$

2.2.4 Ash content using Muffle furnace ash data of the NANDI 65 and PIONEER 8885 was evaluated which was followed by **AOAC, (2000)** 5g sample (NANDI 65 and PIONEER 8885) was taken and loaded in silica crucible. At 600°C for 5 hrs in muffle furnace the sample were kept till white ash get. It was then transferred to muffle furnace and the temperature was raised to and kept for 6 hours until white ash was obtained. After cooling the weight were taken.

$$\textbf{Ash}\ \% = \frac{\textbf{weight of ash}}{\textbf{weight of sample}} \times 100$$

2.2.5. Carbohydrate AAAC, (2000) method) Protein (kjeldhal*6.25), fat, fibred, ash and moisture were calculated content of each sample were determined by differences**.**

%Carbohydrate = (%moisture + %protein + %crude fibre +% fat + % Ash

ISSN PRINT 2319 1775 Online 2320 7876

 Journal Volume 13, Iss 02, 2024

3.1 Development of Pearl millet product noodles NANDI 65 through fermentation

Plate.3.1a) Noodles without fermentation NANDI65 **b) Noodles from NANDI 65 fermentation of 24 hrs**

c) Noodles from NANDI 65 through fermentation 48 hrs **d) Noodles from NANDI 65through fermentation 72 hrs .**

3.1.1 Development of Pearl millet product noodles PIONEER 8885 through fermentation

Plate.3.2 a) Noodles without fermentation Pioneer 8885 **b) Noodles from Pioneer fermentation of 24 hrs**

ISSN PRINT 2319 1775 Online 2320 7876

 Journal Volume 13, Iss 02, 2024

c) Noodles from Pioneer 8885 through fermentation 48 hrs **d) Noodles from Pioneer 8885 through fermentation 72 hrs**

3.1.1 Moisture content (NANDI 65 & PIONEER 8885)

Moisture content of unfermented pearl millet noodles pioneer 8885 is 12.14±0.14 % which is lower than the moisture content of pearl millet (Nandi 65) 24 hours fermented flour. moisture content of fermented flour 48 hours is 12.32±0.25% which is higher than the moisture content of pearl millet (Nandi 65) flour at 24 hours, moisture content of noodles Pioneer 8885 before fermentation (control) ranged 12.14±0.14 % , indicating that the moisture content of fermented pearl millet noodles was more than that of unfermented noodles.**himabindu *et al*., (2015)** reported that moisture content showed result lower than pearl millet flour.shelf life improved as moitue content decreased.

Table 1. Moisture content (%) of noodles from pearl millet

Treatment	NANDI 65	PIONEER 8885
T_o	11.32±0.17	12.14 ± 0.14
T_{24}	11.48 ±0.20	11.49 ±0.42
T_{48}	12.26 ±0.12	12.32 ± 0.25
T_{72}	10.42 ±0.10	11.26 ±0.15

Note: -T_o Non fermented, T_{24} Fermented at 24 hours , T_{48} Fermented at 48 hours, - T_{72} Fermented at 72 hrs

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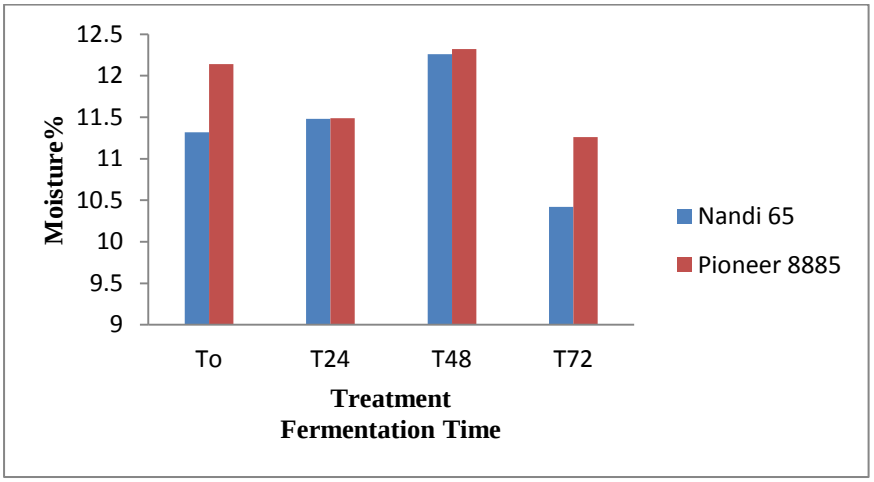

Fig.1 Graphical representation of variation in moisture content of pearl millet noodles (NANDI 65 AND PIONEER 8885)

3.1.2. Protein Content of Pearl Millet Noodles (NANDI 65 and PIONEER 8885)

The following table 2. shows the protein composition of fermented and control pearl millet noodles. Protein content of noodles before fermentation (control) of NANDI 65 ranged 6.26±0.14%. The results shows that the protein content of 24 hr, 48 hrs and 72 hrs pearl millet flour was significantly lower than that of control noodles (NANDI 65) 48 hours. Protein content of fermented flour after 72 hours of NANDI 65 is 5.42 ±0.02% which is lower than the value in 24 hours, i.e. 5.54 ±0.30 %. Protein content of pearl millet variety PIONEER 8885 had almost same value as compared to NANDI 65 noodles and higher than 24 hours.i.e 6.21 ±0.97% and lower value seen in 72 hours pioneer 8885.It is probably due to the more intense proteolysis. **Schettino *et al*.,(2019)**

Table 2. Protein content (%) of noodles from pearl millet
Variation in protein content of pearl millet noodles (NANDI 65 and PIONEER 8885)

Treatment	NANDI 65	PIONEER 8885
T_o	6.26±0.14	6.35±0.12
T_{24}	5.54 ±0.30	6.21 ±0.97
T_{48}	5.26 ±0.20	5.68 ±0.20
T_{72}	5.42 ±0.02	5.62 ±0.20

Note: -T_o Non fermented, T_{24} Fermented at 24 hours T_{48} Fermented at 48 hours, T_{72} Fermented at 72 hrs

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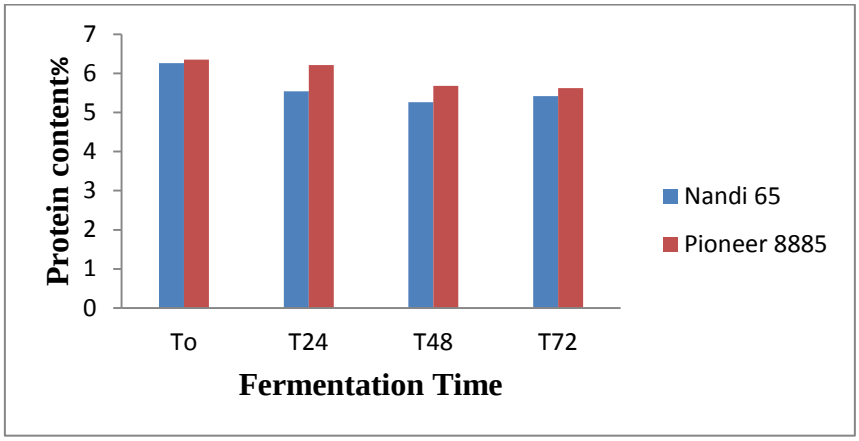

Fig.2. Graphical representation of variation in protein content of pearl millet Noodles (NANDI 65 and PIONEER 8885)

3.1.3. Fat Content of Pearl Millet Noodles NANDI 65 and PIONEER 8885

Before fermentation, the fat content of NANDI 65 variety ranged 4.43±0.28%. The table shows the fat content of the unfermented pearl millet noodles was significantly lower than the fermented noodles 72 hrs. The fat content of fermented noodles at 72 hours is 2.14±0.37% which is lower than the fat content after 24 hours and 48 hours, which is 3.45±0.32% and 2.98±0.45 % respectively. The fat content of noodles PIONEER 8885 before fermentation (control) ranged 5.07±0.71%. Results of fat content showing that the 24 hrs, 48 hrs and 72 hrs pearl millet noodles was significantly lower than that of the unfermented noodles. The fat content of fermented noodles at 72 hours is 2.28±0.15% which is lower than the fat content after 24 hours and 48 hours, which is 3.84±0.07% and 3.26±0.13% respectively. As compared to Nandi 65 higher values seen in fermented noodles (PIONEER 8885).

Table 3.Variation in fat content of pearl millet noodles (NANDI 65 AND PIONEER 8885)

Treatment	NANDI 65	PIONEER 8885
T_o	4.43±0.28	5.07±0.71
T_{24}	3.45±0.32	3.84±0.07
T_{48}	2.98±0.45	3.26±0.13
T_{72}	2.14±0.37	2.28±0.15

Note: -T_o Non fermented, T_{24} Fermented at 24 hours T_{48} Fermented at 48 hours, T_{72} Fermented at 72 hrs

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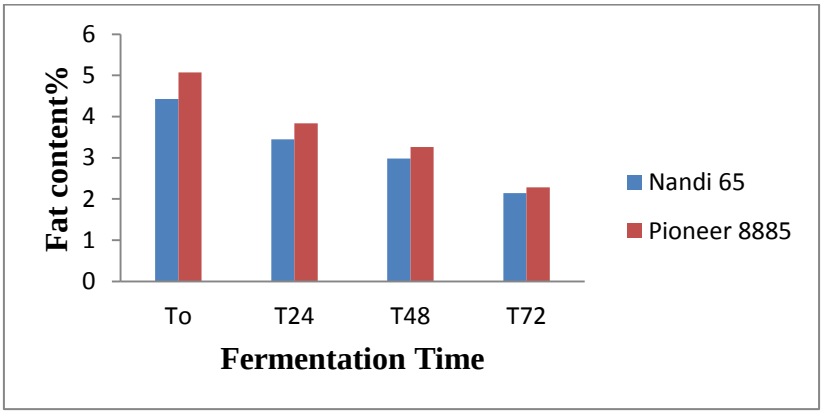

Fig.3. Graphical Representation of variation in fat content of pearl millet noodles (NANDI 65 and PIONEER 8885)

3.1.4. Fibre Content of Pearl Millet Noodles

The fibre content of noodles PIONEER 8885 before fermentation (control) was 1.94%. The fermented pearl millet flour PIONEER 8885 was significantly higher in 72 hours of fermentation. The fibre content increased may be due to depletion of carbohydrate and fat. Human diet consist of dietary fibre plays an important role in digestion, also act as probiotic, and helps in removal of waste from the body. **DeVries *et al*., (2001)**

Table 4. Variation in fibre content of pearl millet noodles (NANDI 65 and PIONEER 8885)

Treatment	NANDI 65	PIONEER 8885
T_o	2.62±0.16	1.94±0.14
T_{24}	2.86±0.12	2.24±0.19
T_{48}	3.48±0.18	3.42±0.18
T_{72}	3.62±0.16	3.46±0.18

Note: -T_o Non fermented, T_{24} Fermented at 24 hours T_{48} Fermented at 48 hours, T_{72} Fermented at 72 hrs

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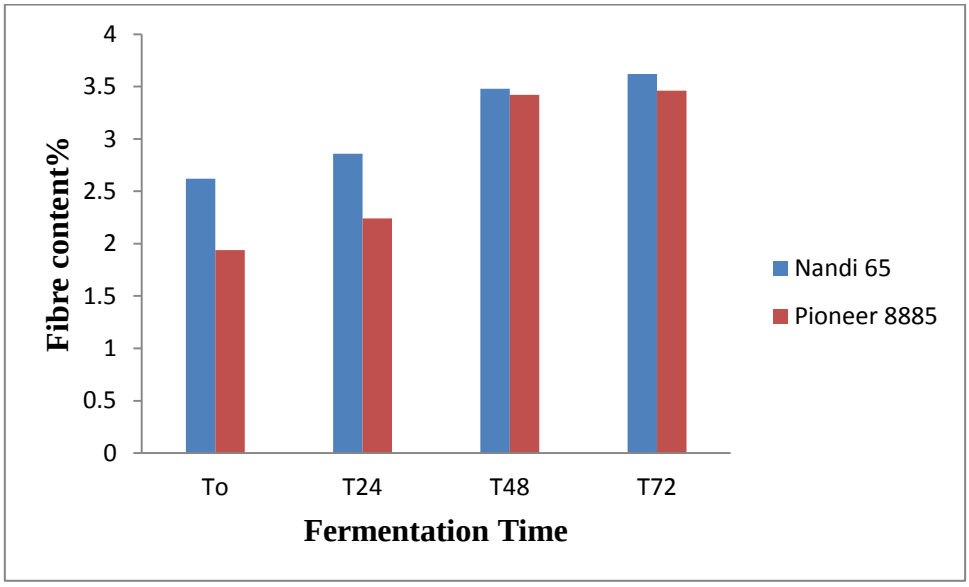

Fig.4. Graphical representation of variation in fibre content of pearl millet Noodles (NANDI 65 and PIONEER 8885)

3.1.5. Ash content in pearl millet noodles

The results show that the ash content of fermented pearl millet noodles (NANDI 65) fermented 24 hrs was significantly higher than the unfermented noodles. The ash content of fermented noodles after 72 hours is 1.42±0.20 % that is lower than the value after 48 hours, which is 1.55±0.11 %. The ash content of noodles PIONEER 8885 before fermentation (control) ranged 0.54±0.51% indicating that the ash content of 24 hrs, 48 and 72 hrs pearl millet noodles was significantly higher than that of unfermented noodles. The ash content of fermented noodles NANDI 65 after 72 hours is 0.16±0.06, which is lower than the ash content after 24 and 48 hours, which is 0.33±0.10 and 0.24±0.03 %, respectively. Pearl millet noodles PIONEER 8885 had higher value as compared to NANDI 65. **Shukla *et al.*, (2014)** Reported that Low ash content in flour is an advantage for noodles because it is responsible for noodle discoloration and the presence of enzyme polyphenoloxidase is believed to be partially responsible for noodle darkening.

Table 5. Variation in ash content of pearl millet noodles (NANDI 65 and PIONEER 8885)

Treatment	NANDI 65	PIONEER 8885
T_o	1.43±0.27	0.33 ±0.10
T_{24}	2.35±0.25	0.54 ±0.51
T_{48}	1.55±0.11	0.52 ±0.03
T_{72}	1.42±0.20	0.16 ± 0.06

Note: -T_o Non fermented, T_{24} Fermented at 24 hours T_{48} Fermented at 48 hours, T_{72} Fermented at 72 hrs

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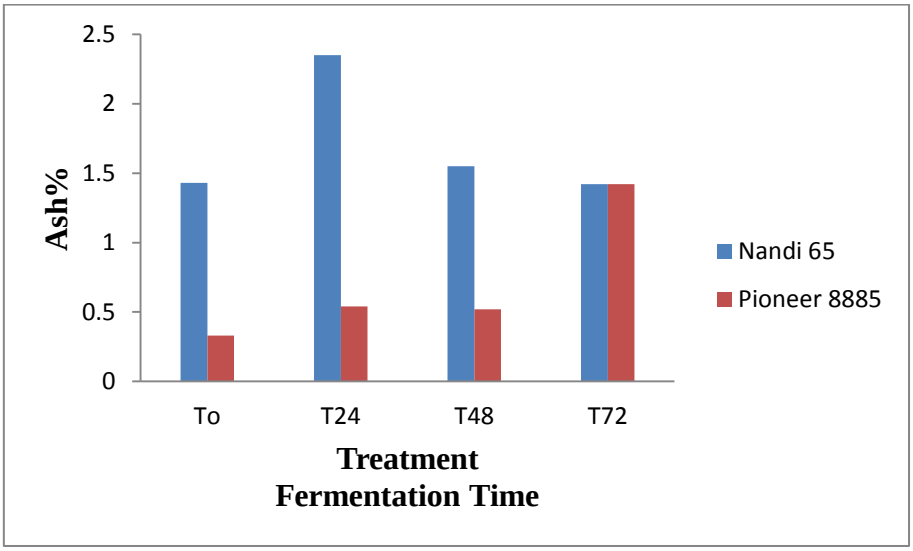

Fig.5. Graphical representation of variation in ash content of pearl millet noodles (NANDI 65 and PIONEER 8885)

3.1.6. Carbohydrate content in pearl millet noodles

Before fermentation (control), the carbohydrate content of noodles (NANDI 65) ranged 78.31±0.09%. The results obtained from carbohydrate content of fermented noodles is less than that of unfermented flour.The carbohydrate content of fermented noodles after 72 hours is 72.48±0.53 % which lower than carbohydrate content after 24 and 48 hours, which is 76.53±0.49 % and 78.26±0.15% respectively. The carbohydrate content of noodles PIONEER 8885 before fermentation (control) ranged 74.25 ±0.15%. The results showed that the fermented pearl millet noodles was lower than that of the unfermented noodles. The carbohydrate content of fermented noodles PIONEER 8885 after 72 hours is 72.65±0.31 % which is nearly the same as the carbohydrate content after 24 and 48 hours, which is 72.39 ±0.24 % and 72.39±0.24% respectively. Higher carbohydrate content seen in NANDI 65 unfermented as well as fermented flour as compared to PIONEER8885.**Vijay Kumar *et al.,*(2009)** reported that carbohydrate, starch, amylase and amylopectic content were reduced significantly with increased level of incorporation of millet flour. Reduction in amylase and amylopectin content was in accordance with starch content of flour.

Table 6. Variation in carbohydrate content of pearl millet noodles (NANDI 65 and PIONEER 8885)

Treatment	NANDI 65	PIONEER 8885
T_o	78.31±0.09	74.25 ±0.15
T_{24}	76.53±0.49	72.39 ±0.24
T_{48}	75.26±0.15	72.39±0.24
T_{72}	72.48±0.53	71.65±0.31

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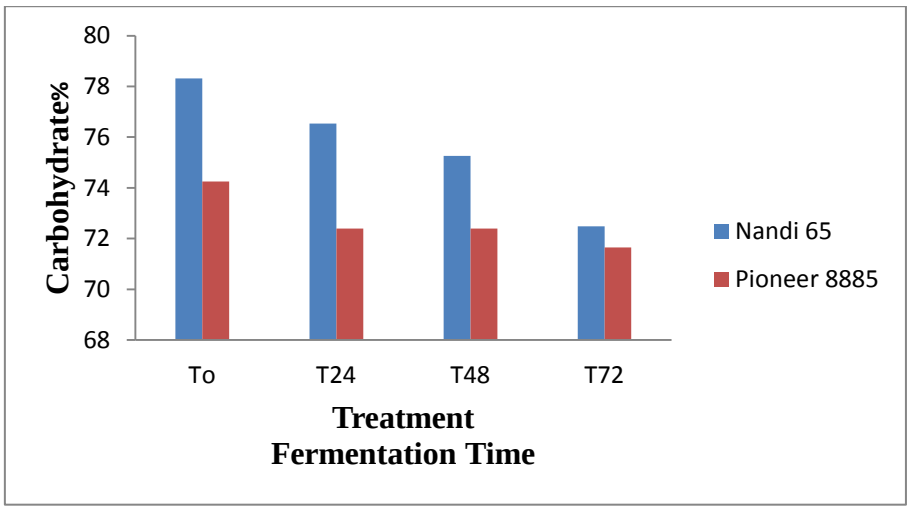

Fig.6. Graphical representation of variation in carbohydrate content of pearl millet noodles (NANDI 65 and PIONEER 8885)

Sensory evaluation of noodles (NANDI 65 and PIONEER 8885)

The sample were produced and evaluated for their liking by a panel of judges‟ by hedonic scale technique. The produced samples were tested for their quality attributes as color, flavor, texture and mouthfeel. The mean acceptability scores obtained by sensory evaluation of noodles. Among different fermentation time noodles has got a highest scores of in fermented 72 hours followed by 24 hrs and 48 hrs least score in 48 hours for the appearance attributes. Regarding the colour attributes the highest score in fermented 72 hours.The texture attribute was found to be maximum in 24 hours. regarding the taste attribute highest score obtained in both the varieties in 72 hours as well as in unfermented Noodles. The overall scores of standard was found highest in 72 hours of fermented Noodles.

Sensory evaluation of pearl millet based product noodles

Table 7. Sensory evaluation of pearl millet product Noodles (NANDI 65)

Parameter	NANDI 65			
	T_o	T_{24}	T_{48}	T_{72}
Colour	7.2±0.74	7.0±0.63	7.2±0.74	7.8±0.40
Taste	7.0±0.63	6.8±0.40	7.2±0.74	7.2±0.74
Flavor	7.4±0.48	7.2±0.74	7.0±0.63	7.6±0.48
Texture	7.4±0.40	7.2±0.17	7.0±0.63	7.6±0.48
Appearence	7.6±0.34	6.4±0.40	7.0±0.63	7.8±0.40
Overall acceptability	7.8±0.40	7.2±0.17	7.2±0.40	7.8±0.17

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 Journal Volume 13, Iss 02, 2024

Note: -T_o Non fermented, – T_{24} Fermented at 24 hours -T_{48} Fermented at 48 hours, - T_{72} Fermented at 72 hrs

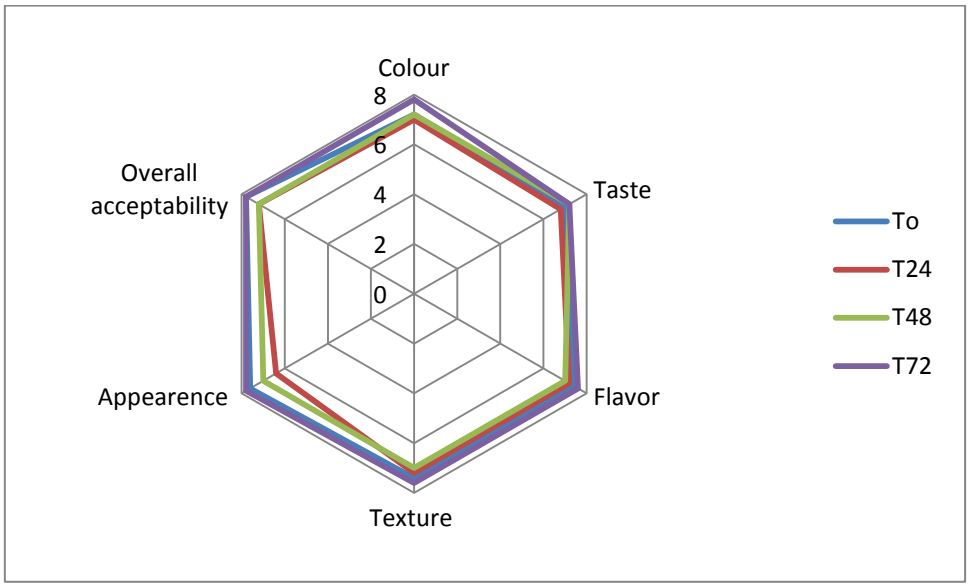

Fig.7. Graphical representation of Sensory evaluation of pearl millet Noodles (NANDI 65)

Table 8. Sensory evaluation of pearl millet product Noodles (PIONEER 8885)

Parameter	PIONEER 8885			
	T_o	T_{24}	T_{48}	T_{72}
Colour	7.0±0.63	7.2±0.74	7.2±0.74	7.9±0.48
Taste	7.0±0.63	7.2±0.74	7.0±0.63	8.2±0.48
Flavor	7.2±0.74	7.2±0.74	7.4±0.48	8.1±0.40
Texture	6.8±0.40	7.2±0.74	7.2±0.74	8.5±0.74
Appearence	6.8±0.40	7.0±0.63	7.2±0.74	8.2±0.40
Overall acceptability	7.0±0.63	6.8±0.40	7.2±0.74	7.9±0.4

Note: -T_o Non fermented, – T_{24} Fermented at 24 hours -T_{48} Fermented at 48 hours, - T_{72} Fermented at 72 hrs

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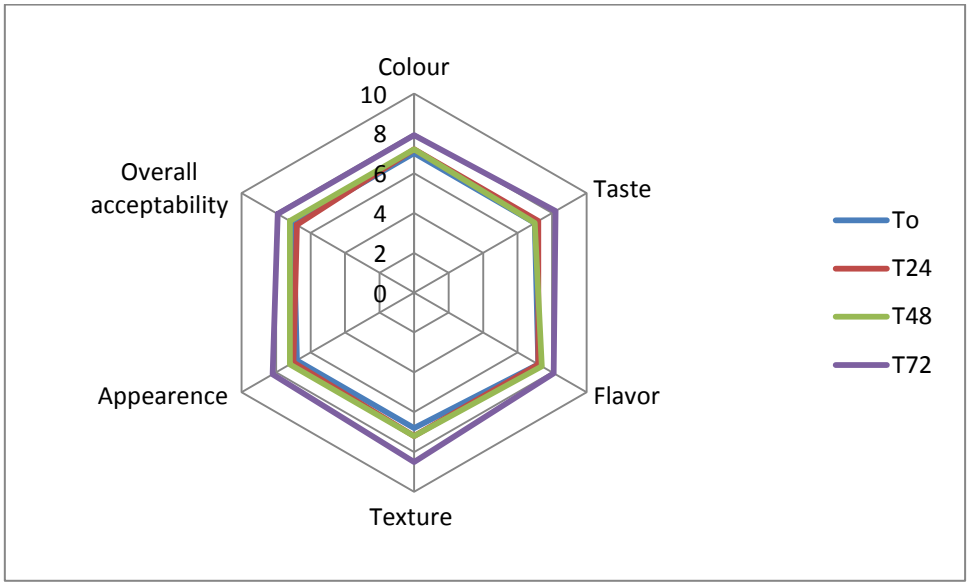

Fig.8.Graphical representation of sensory evaluation of pearl millet Noodles (PIONEER 8885)

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