Journal of Food and Dietetics Research

Original Article

Cooking characteristic and sensory evaluation of cauliflower leaves incorporated homemade noodles

S. Alamelu Mangai[1], K. Divya[1]

[1]PG & Research Dept. of Home Science, Bharathidasan Govt. College for Women (Autonomous), Puducherry-605003, Puducherry-India.

***Corresponding author:**
Alamelu Mangai S,
PG & Research Dept. of Home Science, Bharathidasan Govt. College for Women (Autonomous), Puducherry-605003, Puducherry-India

mangaifsmd19@gmail.com

Received : 24-January-2021
Accepted : 03-February-2021
Published : 03-April-2021

DOI: 10.48165/JFDR.2021.1104

Quick Response Code:

ABSTRACT

Objectives: The present study was carried out with the objective of examining the cooking and sensory attributes of cauliflower leaves *(Brassica oleraceavar. botrytis*) incorporated homemade noodles.

Material and Methods: Noodles in ratio 60:40 (WF:PMF) served as control and the cauliflower leaves puree (CLP) was incorporated to the control noodles in five different proportion such as 10, 20, 30, 40, and 50. The various blends were processed and shadow dried to prepare noodles. Both dry and cooked noodles were subjected to sensory evaluation by trained panel members and the cooking characteristics were estimated.

Results: The water absorption of the noodles increases with increase in the level of CLP, cooking loss reduced with the level of CLP incorporation and was statistically significant at $P < 0.05$ level. Sensory attributes between control and CLP-enriched dry noodles, only flavor and taste was statistically significant at $P < 0.05$ level.

Conclusion: Owing the nutritive value of pearl millet, wheat, and cauliflower leaves, the noodles can replace the commercial noodles in household with minimum cost and can be popularized among foodies especially children and teenagers.

Keywords: Noodles, Pearl millet, Antioxidant, Cauliflower leaves, Homemade

INTRODUCTION

India occupies the first position in the production of cauliflower.[1] Cauliflower (*Brassica oleraceae var. Brotrytis)* belong to the family Brassicaceae, one of the most popular cruciferous vegetable.[2] Brassica are known for the antioxidant activity. *Brassica oleracea var. botrytis* leaves show a presence of very strong health-promoting fatty acids and antioxidants.[3] Cauliflower leaves possess high nutrients 44.5% omega 3 fatty acid.[4] According to the food composition table provided by the National Institution of Nutrition, Hyderabad, India, 100 g fresh cauliflower leaves contain 5.9 g of protein, 1.3 g of fats, 7.6 g of carbohydrates, 2 g of crude fiber, and 66 kcal energy. The dried leaves of cauliflower are good source of β carotene – 43.11 mg, iron – 60.38 mg, copper – 1.55 mg, manganese – 5.86 mg, zinc – 5.10 mg per 100 g.[5] Folate present in cauliflower leaves helps to increase the blood and prevent symptoms of anemia.[6] The presence of macronutrients in domestically processed cauliflower leaves has also been documented.[1,7] Only a few researches have been carried out on utilizing this underexploited leaves which can be consumed as a green leafy vegetable (GLV).

Value-added food products are defined as any product or action that helps in raise the value of the product. As a result of nutritional and economic benefits, supplementation of cereal products with millets has become increasingly popular today. Due to the better nutritive value in terms of complex carbohydrate and high dietary fiber, millets are suitable for making convenient, therapeutic, and ready-to-eat food products[8] and also ready-to-cook products.

Common noodles lack essential nutrients because of usage of refined wheat flour such as dietary fiber, vitamins, minerals which were lost during wheat flour refinement.[9]

Noodles are the first food to be authorized by Food and Drug Administration as a good vehicle for addition of bioactive compound and abundance of biomedical research has been carried out on antioxidant and active compounds derived from plants.[10] Among the plant sources, research on noodles enriched with bioactive compounds of vegetables and green leafy vegetables are less.[11] Studies by various researchers[12] shows the enrichment of noodles with soy flour and carrot powder; orange fleshed potato flour based domestic domestic wheat flour noodles, spinach puree incorporated noodles, and noodles produced from wheat flour, acha, and soybean.

Hence, an attempt was made in the present study to utilize the cauliflower leaves, which are generally thrown away as a waste, in puree form to develope the homemade noodles.

MATERIAL AND METHODS

Selection of cauliflower leaves

Dark green, bright, and tender leaves of cauliflower were purchased from the local market of Puducherry, where the daily market has wholesale and retail sale of cauliflower, trimming the leaves aside and leaving it as a waste. It was also observed that cauliflower leaves are purchased to feed cattle at the rate of Rs. 5 per kg. If the leaves were found pale colored or whitish and hard with strong rib, it was not chosen for the present study.

Processing of cauliflower leaves puree

The fresh cauliflower leaves purchased from the local market were washed, sorted, stalks were removed and the leaves were cut into large pieces. The chopped leaves were blanched for five minutes and the excess of water were drained. The blanched leaves were ground using required amount of water (drained in blanching) and the puree was obtained. This puree was intended to use in the making of noodles. The processing of cauliflower puree was carried out according to Ref.[13]: 10 g of cauliflower leaves yield 5 g of puree and puree was prepared every time the recipe was formulated during the study.

Selection of equipment

The "Divinezon" stainless handy modular equipment was purchased that can be used to prepare noodles, pasta, spaghetti, and fettuccine.

Preparation of noodles

In the present study an attempt was made to make noodles using a homemade manual "Noodles maker." As an alternate for the commercial noodles, an attempt was made to prepare noodles at household level with easily available ingredients.

Step 1 - "Five variations of noodles namely CIND1, CIND2, CIND3, CIND4 and CIND5" was developed by adding cauliflower leaves puree (CLP) at 5, 10, 15, 20 and 25 g in addition to other ingredients namely 40g wheat flour, 60 g pearl millet flour, salt 2 g and oil 5 g as standard quantity in all the above five variations respectively.

Step 2 - The noodles were extruded by hand extruded noodles maker. The thickness of the dough sheet was adjusted on calibration roll. After the thickness of dough sheet was reduced to the desired level, the noodles strips were silted about 2 mm width along the direction of the slitter. The silted noodles were folded to the desired size matching the commercial brand "top ramen" noodles. Each time during standardization, the texture of noodles without breakage, elongated strands with smoothness were ensured.

Step 3 - The strands were allowed to dry by shadow drying method.

Step 4 - Cooking of noodles: The noodles in different variation were separately added to boiling water of 250 ml and cooked till done for five minutes.

Step 5 - The excess water was then drained out, and the noodles were immersed in a bowl of cold water for two minutes.

Thus, cooked noodles with different blends were subjected to cooking characteristics and sensory evaluation.

Cooking characteristics

Water absorption

The water absorption is determined by the ratio of weight of the cooked noodles to the weight of the noodles before cooking as described by AACC method.[14]

$$\text{Water absorption } (\%) = \frac{\text{Weight of cooked noodles} - \text{Weight of raw noodles}}{\text{Weight of raw noodles}} \times 100$$

Swelling index

The swelling index of the cooked noodles was determined according to the procedure described by Ref.[15] The swelling index was expressed as weight of cooked noodles,

$$\text{Swelling Index} = \frac{\text{Weight of cooked noodles} - \text{Weight of noodles after drying}}{\text{Weight of noodles after drying}} \times 100$$

Cooking loss

Cooking loss was determined by measuring the amount of solid substance lost to cooking water. A 10 g sample of noodles

was placed into 300 mL boiling water in a 500 mL beaker. Cooking water was collected in an aluminum dish and placed in oven at 105°C and evaporated to dryness. The residue was weighted and reported as a percentage of starting material.

$$\text{Cooking loss \%} = \frac{\text{Dried residue in cooking water}}{\text{Noodles weighed before cooking}} \times 100$$

Sensory Evaluation

The noodle were cooked and using commercial noodles as control, were subjected to sensory evaluation for different attributes like color, taste, texture, flavor, and overall acceptability. The sensory attribute of prepared noodles were measured with the five points hedonic rating 5 - Like very much, 4 - Like moderately, 3 - Neither like nor dislike, 2 - Dislike moderately, 1 - Dislike very much. The sensory evaluation was carried out with 30 trained panel members.

RESULTS AND DISCUSSION

Cooking characteristics of CLP-enriched noodles

The cooking characteristics [Table 1] such as water absorption, swelling index, and cooking loss were tested only for the CLP-enriched noodles and analyzed statistically.

Water absorption

The water absorption of the noodles increases with increase in the level of CLP, which is evident in the present study as it shows increased level from 106.6 to 203.3. These level are statistically significant at $P < 0.05$ level. The fiber present in the cauliflower leaves have greater water holding capacity.

Swelling index

Swelling index of noodles is an indicator of water absorbed by the starch and protein during cooking which is utilized for the starch gelatinization and protein hydration. The swelling index of the CLP-enriched noodles decreased with increase in the incorporation.

Table 1: Cooking characteristics of cauliflower leaves puree enriched noodles.

Variation	Water absorption	Swelling index	Cooking loss
CINC1	106.6	1.80	7.55
CINC2	130	1.76	7.50
CINC3	170	1.73	7.40
CINC4	185	1.68	6.80
CINC5	203.3	1.65	6.20
SE±	17.81	0.026	0.260
***P* value**	0.000*	0.000*	0.000*

**Significant P < 0.05 level; CINC - Cauliflower leaves puree incorporated noodles – Cooked*

Cooking loss

A progressive reduction in the cooking loss with increase in the level of CLP-enriched noodles was noted, which was statistically significant at $P < 0.05$ level. The same result was found in a study[15] where the incorporation of spinach leaves decreased the cooking loss. This is due to better binding of starch granules with added vegetable puree in gluten matrix.[11]

Sensory evaluation of noodles incorporated with different variations of CLP – dry and cooked

The sensory attributes like color, flavor, taste, texture, and overall acceptability for CLP-enriched noodles were rated by 30 panelist for both dry and cooked noodles. The CLP was incorporated at 5%, 10%, 15%, 20%, and 25% to the accepted variation WF: PMF (60:40) of noodles.

Color

None of the panelist rated "dislike very much" the color of the raw noodles for all the variation of CLP incorporated. A similar percent of 40 and 60 panelist rated equally as "like very much" and "like moderately," respectively, for raw noodles variation CIND4 and CIND5. Only 3.3% of panelist "dislike very much" for 5 g incorporation of CLP as they reported the color was not very appealing when compared to other variations.

In present study, the color of noodles in dry form were noticeably as "pistachio green," the cooking enhanced the color of the cauliflower leaves and it can be termed as "inchworm green." Also the study proves the evidence for exclusion of any artificial colorants to the popular cereal product noodles and hence may be recommended for children, teenagers, and all noodles lovers.

Taste

With regard to the taste, an equal percent of 60 panelist rated "like moderately" for variation CIND4 and CIND5. Whereas, a majority of 76.7% of panelists rated "like very much" for cooked noodles CINC5. None of the panelist rated "dislike very much" for the taste in both dry and cooked noodles of all variations. Thus, in the present study the variation five with (25 g of cauliflower leaves) in cooked form tasted good as it was "liked very much" by the panelist as against its raw form.

Texture

Only 20 percent of panelist rated "dislike moderately" for CIND1. None of the others rated "dislike very much" and "dislike moderately" for all the variations in both dry and

cooked form of the noodles. Majority of 96.6% of panelist rated "neither like nor dislike" to the raw noodles CIND1 due to the less incorporation of cauliflower leaves that did not bring any alteration to the texture. With regard to cooked noodles, a majority of 70% of panelist rated "like very much" for the variation CINC5 followed by an equal percent of 40 panelist for CIND3 and CIND4.

A similar study[5] using cauliflower leaf powder in malted wheat flour noodles showed that 10% incorporation had good texture, whereas the present study has used CLP that had enhanced the smoothness, firmness, chewy and elastic texture of the noodles especially in variation five in both dry and cooked forms.

Flavor

Majority of 96.7% followed by 80% and 60% of the panelist rated "neither like nor dislike" for the variation CIND1, CIND2, and CIND3 due to the bland flavor of cauliflower leaves. An equal percent of 60 panelist rated "like very much" for both the variations CIND4 and CIND5, whereas 50% alone rated the cooked form of CINC5 as "like very much" when compared to CINC4. It was happy to note that none of the panelist "dislike very much" the flavor of the CLP-enriched noodles.

A study[16] opined that 15% incorporation of betel leaf extraction was preferred more by the panelist for its flavor. But in the present study due to characteristic bland nature of cauliflower leaves, 25% of incorporation was well accepted for its flavor though a few reported a raw flavor in 25% incorporation of cooked noodles.

Overall acceptability of CLP-enriched noodles

A majority of 53.3% and 73.3% of panelist rated "like very much" the raw and cooked noodles of variation CIND5 and CINC5, respectively and had depicted their overall acceptability of the product noodles for the variation 60 WF: 40 PMF:25 CLP.

Mean sensory score of CLP incorporated noodles

Table 2 give the mean score for the sensory attributes and overall acceptability of CLP-enriched noodles in both dry and cooked form and Table 3 gives one way ANOVA adopted for the comparison of CLP-enriched dry and cooked noodles.

With regard to the cooked noodles, the sensory attribute color and taste scored high with 4.83 ± 0.3 and 4.76 ± 0.43, respectively. It was noted that the overall acceptability mean score was high (4.50 ± 0.50) and (4.73 ± 0.44) for both raw and cooked noodles respectively for the variation five, that was found to be statistically significant at $P < 0.01$ level. All sensory attributes for raw and cooked noodles were statistically significant at $P < 0.01$ level.

With respect to the sensory attributes, between control and CLP enriched dry noodles, only flavor and taste was statistically significant at $P < 0.05$ level. Whereas in cooked noodles all the sensory attribute and overall acceptability of control noodles vs incorporated were not found to be statistically significant. Within the control noodles in the dry form vs cooked form, the sensory attribute color was found to be significant at $P < 0.05$ and taste significant at $P < 0.01$ level. Within CLP-enriched noodles, the sensory

Table 2: Mean sensory score of cauliflower leaves puree incorporated noodles.

Mean sensory attributes and overall acceptability of control noodle					
Variation	**Color**	**Taste**	**Texture**	**Flavor**	**Overall acceptability**
Cauliflower leaves puree incorporated noodles – Dry					
CIND1	2.80 ± 0.40	2.83 ± 0.37	2.80 ± 0.40	2.80 ± 0.40	3 ± 0.0
CIND2	3.03 ± 0.18	3.33 ± 0.47	3.03 ± 0.18	3.03 ± 0.18	3.03 ± 0.18
CIND3	3.20 ± 0.40	4.37 ± 0.49	4.40 ± 0.49	3.40 ± 0.49	3.40 ± 0.49
CIND4	4.40 ± 0.49	4.40 ± 0.49	4.40 ± 0.49	4.60 ± 0.49	4.40 ± 0.49
CIND5	4.40 ± 0.49	4.40 ± 0.49	4.60 ± 0.67	4.60 ± 0.49	4.50 ± 0.50
***P* value**	0.000**	0.000**	0.000**	0.000**	0.000**
Cauliflower leaves puree incorporated noodles – Cooked					
CINC1	3.7 ± 1.02	3.33 ± 0.66	3.66 ± 0.75	3.53 ± 0.68	3.86 ± 0.68
CINC2	3.73 ± 0.68	3.66 ± 0.54	3.76 ± 0.85	3.53 ± 0.57	3.76 ± 0.67
CINC3	3.80 ± 0.76	3.46 ± 0.57	3.90 ± 0.75	3.60 ± 0.62	3.93 ± 0.69
CINC4	4.06 ± 0.78	4.10 ± 0.54	3.80 ± 0.66	3.60 ± 0.67	4.03 ± 0.76
CINC5	4.83 ± 0.37	4.76 ± 0.43	4.70 ± 0.46	4.50 ± 0.50	4.73 ± 0.44
***P* Value**	0.000**	0.000**	0.000**	0.000**	0.000**

**Significant at P < 0.05 level, **Significant at P < 0.01 level*

Table 3: One-way ANOVA for control vs CLP-enriched noodles.

ANOVA						
Attribute	**Variation**	**Sum of square**	**df**	**Mean square**	**F**	**Sig**
Dry Noodles - Control vs CLP						
Color	CND3 vs CIND5	0.467	1	0.467	2.105	.155^{NS}
Flavor	CND3vs CIND5	1.610	1	1.610	7.261	.010*
Taste	CND3 vs CIND5	1.050	1	1.050	4.444	.0410*
Texture	CND3 vs CIND5	0.038	1	0.038	0.147	.703^{NS}
Overall acceptability	CND3 vs CIND5	0.117	1	0.117	0.449	.506^{NS}
Cooked Noodles – Control vs CLP						
Colour	CNC3 vs CINC5	0.536	1	0.536	3.025	0.90
Flavor	CNC3 vs CINC5	0.536	1	0.536	2.198	0.140
Taste	CNC3 vs CINC5	0.002	1	0.002	0.013	0.912
Texture	CNC3 vs CINC5	0.010	1	0.010	0.42	0.838
Overall acceptability	CNC3 vs CINC5	0.86	1	0.86	0.455	0.504
Control noodles – Dry vs Cooked						
Color	CND3 vs CNC3	1.042	1	1.042	5.008	0.036*
Flavor	CND3 vs CNC3	6.042	1	6.042	0.234	0.633^{NS}
Taste	CND3 vs CNC3	4.167	1	4.167	21.154	0.000*
Texture	CND3 vs CNC3	0.000	1	0.000	0.000	1.000^{NS}
Overall acceptability	CND3 vs CNC3	0.372	1	0.372	1.800	0.193^{NS}
CLP-enriched noodles - Dry vs Cooked						
Color	CIND5 vs CINC5	2.817	1	2.817	14.372	0.000*
Flavor	CIND5 vs CINC5	0.150	1	0.150	0.592	0.445^{NS}
Taste	CIND5 vs CINC5	0.150	1	0.150	0.446	0.507^{NS}
Texture	CIND5 vs CINC5	2.017	1	2.017	9.308	0.003*
Over all acceptability	CIND5 vs CINC5	0.600	1	0.600	2.610	0.112^{NS}

**significant at P < 0.05 level, **significant at P < 0.01 level and NS- Not significant*

CND3 – Control noodle – Dry (WF60: PMF40),CNC3 – Control noodles cooked (WF 60:PMF 40), CIND5 – Cauliflower leaves puree incorporated noodles - Dry (WF 65:PMF 20:CLP15), Cauliflower leaves puree incorporated noodles – Cooked (WF 65:PMF 20:CLP15)

attribute color and texture were found to be significant at $P < 0.01$ level.

CONCLUSION

In the present study, CLP was incorporated at 5%, 10%, 15%, 20%, and 25% to the accepted control noodles WF:PMF (60:40). The water absorption of the noodles increases with increase in the level of CLP, that had an increased level from 106.6 to 203.3, as the fiber present in the cauliflower leaves have greater water holding capacity, and was statistically significant at $P < 0.05$ level. Swelling index of noodles, an indicator of water absorbed by the starch and protein during cooking which is utilized for the starch gelatinization and protein hydration, decreased with increase in the incorporation of CLP. Cooking loss, an indicator of noodles resistance to cooking, showed a progressive reduction with increase in the level of CLP incorporation which was statistically significant at $P < 0.05$ level.

With regard to sensory evaluation, none of the panelist rated "dislike very much" the color of the raw noodles for all the variations of CLP and for the taste in both dry and cooked noodles of all variations. Thus, in the present study the variation five with (25 g of cauliflower leaves) in cooked form tasted good as it was "liked very much" by the panelists as compared with its raw form. With respect to the sensory attributes, between control and CLP-enriched dry noodles, only flavor and taste was statistically significant at $P < 0.05$ level.

Owing the nutritive value of pearl millet, wheat, and cauliflower leaves, the noodles can replace the commercial noodles in household with minimum cost and can be popularized among foodies especially children and teenagers. Further study on improvement of iron and calcium level in clinical trials supplementing the CLP noodles is recommended.

ACKNOWLEDGEMENTS

This paper is the outcome of postgraduate research study without any financial support.

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

Financial support and sponsorship

Nil.

Conflict of Interest

There are no Conflicts of Interest.

REFERENCES

1. Mogra R, Banga J, Rathi P. Nutrient composition of cauliflower (Brassica oleracea var. Botrytis) leaf powder and its acceptability in fast food. Food Sci Res J 2012;3:167–71.
2. Ambrosone CB, Tang L. Cruciferous vegetable intake and cancer prevention: role of nutrigenetics. Cancer Prev Res (Phila Pa) 2009;2:298–300.
3. Deng G.-F, Lin X, Xu XR, Gao LL, Xie JF, Li. HB. Antioxidant capacities and total phenolic contents of 56 vegetables, J Funct Food 2013;5:260–6.
4. Sharmilan MJP, Jaganathan D. Bioactive compounds in cauliflower leaves (Brassica oleracea var. botrytis) using GCMS, Int J Sci Res 2016;7;10459–63.
5. Wani M, Sood and Kaul, RK. Nutritional and sensory properties of roasted wheat noodles supplemented with cauliflower leaf powder. Annals Food Sci Technol 2011;12:102–7.
6. Brittenham GM, Disorders of iron gimetabolism: Iron deficiency and iron overload. In: Hoffman R, et al. Hematology: Basic Principal and Practice. 5th ed. Philadelphia (PA): Churchill Livingstone Elsevier; 2009.
7. Chakraborty S, Datta S. Estimation of macro-nutrients in domestically processed cauliflower leaf powder, Int J Sc Res 2014;2319–7064.
8. Surekha N, Ravikumar S, Naik, Mythri, S. Barnyard millet cookies: Development value addition, consumer acceptability, nutritional and shelf life evaluation. IOSR J Environ Sci 2013;7:1–10.
9. Maberly G (2003) http://www.sph.emory.edu/wheatflour/training/resources/tech resources.htm.
10. Block G, Patterson B, Subhar A. Fruit, vegetables and cancer prevention: a review of epidemiological evidence. Nutrition Cancer 1992;18:1–29.
11. Rekha MN, Chauhan AS, Prabhashankar P, Ramteke RS, Venkateswara Rao G. Influence of vegetable paste on quality attributes of pastas made from bread wheat (T.Aestivum) Cyta. J Food 2013;11:142–9.
12. Adegume MO, Bakare HA, Akinola OF. Enrichment of noodles with soy flour and carrot powder. Nigerian Food J 2012;30:74–81.
13. Shere PD, Devkatte AN, Pawar VN. Studies on production of functional noodles with incorporation of spinach puree, Int J Curr Microbiol Applied Sci 2018;7:1618–28.
14. AACC 2005. Approved methods of the American Association of cereal chemists. St. Paul, Minnesota.
15. Cleary L, Brennan C. The influence of (1→3) (1→4) β glucan rich fraction from barley on the physicochemical properties and in vitro reducing sugars release of duram wheat pasta. Int J Food Sci Technol 2006;41:910–8.
16. Nouri L, Nafchi AM, Karim AA, Mechanical and sensory evaluation of noodles incorporated with betel leaf powder, Int J Food Eng 2015;11:221–7.

How to cite this article: Alamelu Mangai S, Divya K. Cooking characteristic and sensory evaluation of cauliflower leaves incorporated homemade noodles. J Food Diets Res 2021;1(1):19–24.