Acta Scientific NUTRITIONAL HEALTH (ISSN:2582-1423)

Volume 9 Issue 8 August 2025

Research Article

Proximate Composition and Physico-chemical Properties of Amaranthus Noodles as Influenced by Different Puree Ratios

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Received: July 11, 2025
Published: July 29, 2025

Abstract

Amaranthus has bioactive compounds of antioxidants like gallic acid and betalain that may offer cholesterol-lowering effects. Blending amaranthus puree with wheat or rice flours can improve palatability and gluten-free fortified food. This study was carried out at the Food Science and Technology Department, Yezin Agricultural University, to assess proximate composition and physico-chemical properties of amaranthus noodles affected by different puree ratios. The experiment was allocated in a randomized complete block design with four replications including six treatments of control (0 ml) and 5, 9, 13, 17, and 21 ml in 100 gm of wheat flour, respectively.

The proximate composition such as moisture, crude fiber, crude protein, crude fat, ash, and carbohydrates of amaranthus noodles were analyzed at day 0 and day 45. In addition, the color measurements for lightness (L*), redness (a*), yellowness (b*), and water activity (aw) were also examined at 2-week intervals. The amaranthus noodles significantly increased in the moisture, fiber, protein, and ash content during the storage days. There was a progressive gradual increase in fiber, protein, and ash content whereas carbohydrate and fat contents dramatically decreased as compared to control. The determination of greenness (a*) significantly increased throughout the storage period and the highest a* value was observed in the 21 ml of amaranthus treated puree. Therefore, the higher the puree concentration, the higher the a* value was observed. Based on water activity (aw) and moisture content, the data indicated that the product was still safe for consumption up to 45 days. Among the treatments, the amaranthus noodle treated with 21 ml was observed to be the most effective for nutritional fortification in addressing micronutrient deficiencies. As a result, amaranthus noodles might be utilized as a dietary fortifier in the future development of noodle production and could increase the bioavailability of minerals for human health.

Keywords: Amaranthus Noodles; Puree; Physico-Chemical; Proximate Composition

Abbreviations

Consumption of noodles has increased in the world because of their convenience, palatability, shelf stability, and affordability [1]. Changing eating styles are energy-dense food consumption, decreased physical activity, and low consumption of vegetables and whole grains have led to the development of chronic diseases such as coronary heart disease, cancer, and childhood obesity [2]. Noodles are the processed foods of ancient times of Asian origin, still popular in Southeast Asia especially China, Japan, Indonesia, Thailand, Korea and Malaysia [3]. Asian countries love noodles as a "global food", regardless of age. Amaranthus (*Amaranthus viridis*) has a higher protein content and it is a good source of vitamin A for human consumption. Amaranthus contains eight kinds of necessary amino acids (particularly lysine and methionine), dietary fiber, bioactive compounds (e.g., polyphenols) and minerals such as magnesium, calcium, potassium, copper, phosphorus, zinc, and iron for the human body [4]. Its gluten-free nature also makes it suitable for developing alternative pasta and noodle products for healthconscious consumers [5]. However, incorporating amaranthus into noodle formulations is challenging due to its lack of gluten, which affects texture and structural integrity.

Traditional noodle production relies on wheat flour, but the functional and gluten-free products have occurred due to innovation in ingredient substitution. Amaranthus puree is a processed form of amaranthus leaves that can enhance nutritional value while influencing dough elasticity, cooking properties, and sensory attributes. However, the proportion or ratio of amaranthus puree to wheat flour critically affects the proximate composition of (protein, fiber, micronutrients) and physico-chemical properties of (texture, cooking loss, water absorption, color) are essential to balance nutritional enrichment with acceptable product quality [6]. The incorporation of vegetables such as amaranthus, pumpkin, asparagus, spinach, carrot, and broccoli into noodles is rich in carotenoid pigments and phenolic compounds [7].

Therefore, there is limited research information on amaranthus puree-based noodles by the use of underutilized crops like amaranth, promoting agro-biodiversity to assess the proximate composition of amaranthus noodles affected by different puree ratios and to evaluate the proper formulation for nutritious and high-quality amaranthus noodles. This research contributes to the development of functional noodles that meet both nutritional and sensory expectations by the consumers and that may support food security and health initiatives.

Materials and Methods

Experimental site and Duration

This experiment was conducted at the Department of Food Science and Technology (FST), Yezin Agricultural University (YAU) from July, 2024 to August, 2025. There were six treatments (0, 5, 9, 13, 17, and 21 ml) of amaranthus puree for noodle making, respectively. The experiment was laid out in randomized complete block design (RCBD) with four replications.

Procurement of amaranthus noodles

Noodles were prepared according to the method described by [8] with some modifications. All ingredients (wheat flour, whole egg, amaranthus puree, and water) were weighed accurately and mixed for 5 minutes to form a crumbly mixture. All ingredients were kneaded manually for 30 minutes to develop gluten structure. The dough was covered with a damp cloth and rested for 3 hours to improve elasticity. Using a rolling stick, the dough was shaped into a sheet and the sheet was passed through a manual noodle machine with a regular mold for uniform thickness and shape. And then, the fresh noodles came out from the machine, and spread them with a little flour to keep them from sticking and tangling together. Noodles were dried at 50°C for 6 to 8 hours according to the treatment by hot air oven drying. Dried noodles were packed into each aluminum foil pack by weighing 55 g of dried samples and then the packages were stored at room temperature to evaluate physico-chemical properties and cooking qualities of dried amaranthus noodles.

Preparation of Amaranthus puree

Fresh amaranthus leaves were collected from a local market in Yezin area, Nay Pyi Taw, for puree preparation. De-stalked leaves were sorted, washed, cut into pieces, and then steam-cooked and ground by blender. The mass was passed through muslin cloth to get the homogenous amaranthus puree.

Data collection

The proximate composition (moisture, crude fat, crude protein, total ash, and fiber) was determined by [9] method and the data were collected at day 0 and day 45. The total carbohydrate was also determined by subtracting the sum of other values in the percentage of moisture, fiber, ash, fat and protein from 100% [10]. The color value of (L*, a* and b*), and water activity (a_w) of dried noodles were also measured.

Data analysis

All collected data were statistically subjected to analysis of variance (ANOVA) using Statistix 8.0 version software, and treatment means were compared using the least significant difference (LSD) test at a 5% level of significance ($P \leq 0.05$).

Results and Discussion

Moisture content

The effect of different puree ratios on moisture content of amaranthus noodles is presented in Table 1. In this result, there were highly significant differences in the moisture content of noodles; it gradually increased during the storage period. The highest ratio of 21 ml amaranthus puree showed the range of moisture content from 10.88 to 11.38%, while the lowest ratio of 5 ml amaranthus puree was from 9.97 to 10.08%. Among the treatments, the highest moisture content (11.38%) was observed in the 21 ml puree-treated noodle, and the lowest one (9.99%) was observed in the control on day 45. According to [11], dried pasta and noodles should maintain a moisture level below 12–13% to prevent microbial growth. When spinach puree was combined with wheat flour to make dough, it produced an uneven dough and increased moisture retention because it included tiny, fine cellulose matter particles [12]. Dewi (2011) [13] also reported that the moisture content of noodles was increased with the addition of amaranthus puree along the storage period.

Treatments	Moisture Content (%)	
	0 DAS	45 DAS
Control	9.35 e	9.99 d
AP_5	9.97 d	10.08 d
AP_9	10.05 cd	10.40 c
AP_{13}	10.38 bc	10.55 c
AP_{17}	10.57 ab	10.98 b
AP_{21}	10.88 a	11.38 a
$LSD_{0.05}$	0.39	0.28
Pr>F	**	**
CV%	2.50	1.74

Table 1: Effect of different puree ratios on moisture content (%) of dried amaranthus noodles at 0 DAS and 45 DAS.

In a column, means followed by the same letters are not significantly different at P≤ 0.05.

** = significant at 1 % level AP = Amaranthus Puree

Crude fiber

The effect of different puree ratios on crude fiber of amaranthus noodles is described in Table 2. In this result, there were highly significant differences in the crude fiber of noodles. The crude fiber content gradually decreased during the storage period. The highest ratio of 21 ml amaranthus puree showed the range of crude fiber content from 3.34 to 3.16%, while the lowest ratio of 5 ml amaranthus puree was from 2.54 to 2.52%. Among the treatments, the highest crude fiber content (3.34%) was observed in the 21 ml puree-treated noodle, and the lowest one (1.34%) was observed in the control on day 0. Amaranthus is naturally rich in dietary fiber, particularly insoluble fiber such as cellulose and hemicellulose, which contributes to the structural integrity of plant tissues [14]. Dewi (2011) [13] also observed that noodles with seaweed puree increased when the amount of crude fiber content was increased. This may be due to the initial crude fiber content increasing as the concentration of amaranthus puree increased.

Treatments	Crude Fiber (%)	
	0 DAS	45 DAS
Control	1.34 e	1.31 e
AP_5	2.54 d	2.52 d
AP_9	2.57 d	2.54 d
AP_{13}	2.68 c	2.66 c
AP_{17}	3.08 b	2.88 b
AP_{21}	3.34 a	3.16 a
$LSD_{0.05}$	0.05	0.09
Pr>F	**	**
CV%	1.29	2.34

Table 2: Effect of different puree ratios on crude fiber (%) of dried amaranthus noodles at 0 DAS and 45 DAS.

In a column, means followed by the same letters are not significantly different at P≤0.05.

** = significant at 1 % level AP = Amaranthus Puree

Ash content

The effect of different puree ratios on ash content of amaranthus noodles is presented in Table 3. In this result, there were highly significant differences in the ash content of noodles. The crude ash content gradually decreased during the storage period. The highest ratio of 21 ml amaranthus puree showed the range of ash content from 1.26 to 1.22%, while the lowest ratio of 5 ml puree treated ranged from 1.14 to 1.03%. Among the treatments, the highest ash content (1.22%) was observed in the 21 ml puree-treated noodle, and the lowest one (0.74%) was observed in the control on day 45. This finding was similar to [15], who observed that the ash content of the noodles increased when the concentration of fenugreek leaves puree increased.

Treatments	Ash content (%)	
	0 DAS	45 DAS
Control	1.06 e	0.74 e
AP_5	1.14 d	1.03 d
AP_9	1.16 cd	1.06 d
AP_{13}	1.19 bc	1.11 c
AP_{17}	1.21 b	1.17 b
AP_{21}	1.26 a	1.22 a
$LSD_{0.05}$	0.04	0.04
Pr > F	**	**
CV%	2.36	2.52

Table 3: Effect of different puree ratios on ash content (%) of dried amaranthus noodles at 0 DAS and 45 DAS.

In a column, means followed by the same letters are not significantly different at P≤0.05.

** = significant at 1 % level AP = Amaranthus Puree

Crude fat

The effect of different puree ratios on the crude fat content of amaranthus noodles is presented in Table 4. In this result, there were highly significant differences in the crude fat content of noodles. The crude fat content gradually decreased during the storage period. The highest ratio of 21 ml treated puree showed the range of crude fat content from 1.92 to 1.84% while the lowest ratio of 5 ml amaranthus puree was from 2.64 to 2.43%. Among the treatments, the highest crude fat content (2.69%) was observed in the control and the lowest one (1.92%) was observed in the 21 ml puree treated noodle on day 0. This finding was similar to [16] who observed that fat content slightly decreased with increase in the level of amaranthus puree in noodles. This might be due to the addition of amaranthus puree in flour that may decrease the fat content. Shere, Devkatte and Pawar (2018) [17] revealed that amaranthus puree has a lot of fiber while its crude fat content was reduced. The inclusion of amaranthus flour increases; fiber content rises significantly due to its inherent high dietary fiber. Conversely, the fat content often decreased and they were inversely correlated in this study.

Treatments	Crude Fat (%)	
	0 DAS	**45 DAS**
Control	2.69 a	2.57 a
AP_5	2.64 b	2.43 b
AP_9	2.46 c	2.29 c
AP_{13}	2.23 d	2.15 d
AP_{17}	2.19 d	1.94 e
AP_{21}	1.92 e	1.84 f
$LSD_{0.05}$	0.05	0.09
Pr > F	**	**
CV%	1.53	2.68

Table 4: Effect of different puree ratios on crude fat (%) of dried amaranthus noodles at 0 DAS and 45 DAS.

In a column, means followed by the same letters are not significantly different at P ≤ 0.05.

** = significant at 1 % level AP = Amaranthus Puree

Crude protein

The effects of different puree ratios on the crude protein content of amaranthus noodles are shown in table 5. In the present study, there were highly significant differences in the crude protein content of noodles. The crude protein content of all treatments gradually decreased during the storage period. However, it has been found that adding the increased concentration of amaranthus puree enhanced the crude protein content of all treatments. In this study, the highest ratio of 21 ml amaranthus puree showed the range of crude protein content from 11.33 to 11.29, while the lowest ratio of 5 ml amaranthus puree **was fr**om 10.93 to 10.90. This range was similar to [15], who found that the crude protein content of amaranthus noodles ranged from 10.52% to 13.85%. Among the treatments, the highest crude protein content (11.29%) was observed in 21 ml puree-treated noodles, while the lowest crude protein content (10.38%) was observed in the control on day 45. This may be due to amaranthus being a good source of high-quality protein with well-balanced amino acids. This finding was revealed by [18], who found that protein content in amaranthus leaf is higher than that of other leafy vegetables.

Treatments	Crude Protein (%)	
	0 DAS	45 DAS
Control	10.45 e	10.38 e
AP $_{5}$	10.93 d	10.90 d
AP $_{9}$	11.13 c	11.07 c
AP $_{13}$	11.21 b	11.16 b
AP $_{17}$	11.29 a	11.20 b
AP $_{21}$	11.33 a	11.29 a
LSD $_{0.05}$	0.05	0.09
Pr > F	**	**
CV%	0.27	0.54

Table 5: Effect of different puree ratios on crude protein (%) of dried amaranthus noodles at 0 DAS and 45 DAS.

In a column, means followed by the same letters are not significantly different at P≤0.05.

** = significant at 1 % level AP = Amaranthus Puree

Lightness (L*)

The effect of different puree ratios on the lightness (L*) values of amaranthus noodles is presented in Table 6. In this result, there were highly significant differences in the lightness (L*) values of noodles. The lightness (L*) values gradually decreased during the storage period. The highest ratio of 21 ml amaranthus puree showed the lightness (L*) values ranging from 37.36 to 30.70, while the lowest 5 ml amaranthus puree was in the range of 53.01 to 43.72. Among the treatments, the highest L* value (44.62) was observed in the control, and the lowest L* value (30.70) was observed in the 21 ml puree-treated noodle on day 84. This finding was similar to [17], who observed that the control sample of noodles had a higher L* value than amaranthus noodles. Moreover, this author revealed that lightness decreased continuously and progressively with an increase in amaranthus puree concentration in the noodle.

Treatments				Lightness(L*)			
	0	14	28	42	56	70	84
Control	54.28 a	52.09 a	51.37 a	49.02 a	47.81 a	46.34 a	44.62 a
AP $_{5}$	53.01 a	50.11 b	49.39 b	47.51 b	46.01 b	44.53 b	43.72 b
AP $_{9}$	49.13 b	46.34 c	46.25 c	45.72 c	44.59 c	43.51 c	41.05 c
AP $_{13}$	48.19 bc	44.84 d	44.40 d	43.23 d	42.79 d	42.03 d	39.52 d
AP $_{17}$	46.01 c	42.28 e	42.15 e	41.59 e	40.90 e	40.78 e	38.86 d
AP $_{21}$	37.36 d	36.13 f	34.16 f	32.10 f	31.13 f	30.88 f	30.70 e
LSD $_{0.05}$	2.33	0.99	1.07	0.82	0.68	0.75	0.89
Pr>F	**	**	**	**	**	**	**
CV%	3.22	1.46	1.6	1.25	1.06	1.2	1.49

Table 6: Effect of different puree ratios on lightness (L*) of noodles.

In a column, means followed by the same letters are not significantly different at P ≤ 0.05.

** = significant at 1 % level AP = Amaranthus Puree

Redness (a*)

The color (a*) of amaranthus noodles can be influenced by the puree ratio used in the formulation. The positive value refers to a* with a red color, and the negative a* refers to the green color, respectively. The effect of different ratios of puree on the a* value in the green color of amaranthus noodles is presented in table 7. In this study, there were highly significant differences in the a* (green color) value of noodles. The a* (green color) values gradually decreased during the storage period. The a* (green color) value of the amaranthus noodle treated by 5 ml was 2.60, while the noodle treated by 21 ml was 4.26 on day 0. The highest ratio of 21 ml amaranthus puree showed the range of a* (green color) values from -4.26 to -1.78, while the lowest ratio of 5 ml amaranthus-treated noodle ranged from -2.60 to -0.35 on day 84. Among the treatments, the highest a* value (-1.78) was observed in the 21 ml puree-treated noodle, while the lowest one (-0.35) was observed in the 5 ml puree-treated noodle. This finding was similar to [17], who observed that the green color in amaranthus noodles progressively increased with an increase in the level of amaranthus-treated puree.

Treatments					a* values		
	0	**14**	**28**	**42**	**56**	**70**	**84**
Control	4.63 e	3.50 e	3.14 e	2.87 f	2.78 f	2.51 f	2.28 f
AP_5	- 2.60 d	- 2.26 e	- 1.51 e	- 1.07 e	- 0.91 e	- 0.52 e	- 0.35 e
AP_9	- 2.59 d	- 2.45 d	- 2.26 d	- 1.72 d	- 1.12 d	- 0.96 d	- 0.86 d
AP_{13}	- 2.88 c	- 2.60 c	- 2.40 c	- 2.20 c	- 1.75 c	- 1.46 c	- 1.32 c
AP_{17}	- 3.21 b	- 2.85 b	- 2.59 b	- 2.40 b	- 2.25 b	- 1.49 b	- 1.39 b
AP_{21}	- 4.26 a	- 3.14 a	- 2.86 a	- 2.66 a	- 2.33 a	- 2.21 a	- 1.78 a
$LSD_{0.05}$	0.14	0.1	0.12	0.15	0.17	0.11	0.09
Pr > F	**	**	**	**	**	**	**
CV%	2.83	2.35	3.39	4.69	6.72	5.53	4.98

Table 7. Effect of different puree ratios on greenness (a*) values of noodles.

In a column, means followed by the same letters are not significantly different at P≤ 0.05.

** = significant at 1 % level AP = Amaranthus Puree

Yellowness (b*)

The effect of different puree ratios on the yellowness (b*) values of amaranthus noodles is presented in table 8. In this result, there were highly significant differences in the yellowness (b*) values of noodles. The yellowness (b*) values gradually increased during the storage period. The highest ratio of 21 ml amaranthus puree showed b* values from 10.59 to 14.93, while the lowest 5 ml amaranthus-treated noodle ranged from 14.08 to 16.09 from day 0 to day 84. Among the puree treatments, the highest b* value (16.76) was observed in the control, and the lowest b* value (14.93) was observed in the 21 ml puree-treated noodle on day 84. On the other hand, a decreasing trend of b* values indicated a decrease in yellowness in amaranthus noodles. This means that the color of noodles is contributed by the natural green color of the spinach variety [19]. Chen & Huang (1998) [20] reported that chlorophyll is highly unstable during storage, especially under oxygen and light exposure, leading to the formation of pheophytin, which enhances yellowness.

Treatments				b*values			
	0	14	28	42	56	70	84
Control	15.34 a	15.96 a	15.99 a	16.14 a	16.38 a	16.70 a	16.76 a
AP_5	14.08 b	14.61 b	15.76 a	15.81 a	15.83 b	15.85 b	16.09 b
AP_9	13.36 c	13.78 c	15.75 a	15.78 a	15.80 b	15.77 b	15.87 b
AP_{13}	12.81 d	13.01 d	14.47 b	14.95 b	15.61 bc	15.63 bc	15.84 b
AP_{17}	11.41 e	11.49 e	14.15 b	14.24 c	15.41 c	15.50 c	15.53 c
AP_{21}	10.59 f	10.69 f	13.43 c	13.65 d	14.27 d	14.32 d	14.93 d
$LSD_{0.05}$	0.38	0.57	0.52	0.48	0.24	0.25	0.26
Pr>F	**	**	**	**	**	**	**
CV%	1.95	2.87	2.29	2.09	1.02	1.05	1.04

Table 8: Effect of different puree ratios on yellowness (b*) of noodles.

In a column, means followed by the same letters are not significantly different at P≤ 0.05.

** = significant at 1 % level AP = Amaranthus Puree

Water Activity (a_w)

Water activity (a_w) is important in determining the shelf life of food products. The effect of different puree ratios on the water activity of amaranthus noodles is presented in table 9. There were no differences in the water activity value of noodles. The highest water activity value (0.65) was found in the control, and the lowest water activity value (0.63) was observed in the 21 ml puree-treated noodle. In this study, the water activity value gradually increased during the storage period. The highest ratio of 21 ml amaranthus puree showed the range of water activity from 0.61 to 0.63, while the lowest ratio of 5 ml amaranthus puree showed the range from 0.63 to 0.65. This slight rise in the water activity of amaranthus noodles can be caused by the penetration of water vapor into the noodles from the surroundings (changes in relative humidity and temperature) since the product is hygroscopic [21]. This finding was similar to [22], who observed that dried products should contain water activity less than 0.65; therefore, the highest water activity value of amaranthus noodles is within the acceptable range and is still safe to eat.

Conclusion

The incorporation of amaranthus puree into noodle formulations significantly influences the proximate composition, color, moisture, and water activity (a_w), offering both nutritional enhancements and technical challenges. The higher initial moisture retention resulted in longer drying times due to the high content of amaranthus puree and hydrophilic compounds. The water activity (a_w) of amaranthus noodles was less than 0.63 in the final product, extending shelf life. This study demonstrated that 21 ml puree-treated noodles enhanced nutritional value, including higher ash content, crude protein, crude fiber, and moisture content, while maintaining a lower crude fat content compared to the control. The use of amaranthus puree changed the dough's elasticity and requires processing technology with few modifications. In terms of cooking quality, 21 ml puree-treated noodles required a shorter cooking time compared to the control, while exhibiting higher water absorption and swelling index due to the higher weight of the noodle. This may be due to the starch gelatinization and the high amylopectin content and fiber structure of amaranthus, which en-

Treatments	Water activity (a_w)	
	0 DAS	45 DAS
Control	0.63	0.65
AP_5	0.63	0.64
AP_9	0.62	0.64
AP_{13}	0.62	0.64
AP_{17}	0.62	0.64
AP_{21}	0.61	0.63

Table 9: Effect of different puree ratios on water activity (a_w) of noodles at 0 DAS and 45 DAS.

hances water retention. When compared to the control, the noodles treated with 21 ml puree exhibited lower lightness (L*) with higher greenness (a*) that resulted in lower yellowness (b*) values based on the results. It can be assumed that the natural pigments in amaranthus have an impact on the color and appearance of the noodles. The results revealed that the noodles treated with 21 ml puree had the highest physico-chemical properties during the storage period compared to the control. Therefore, 21 ml puree-treated noodle was the optimum fortification level and a promising functional noodle due to their moderate glycemic index and high dietary fiber content, which reduces the starch breakdown rate for digestibility, and their richness in micronutrient contents.

Acknowledgments

The author would like to express sincere thanks to my supervisor and supervisory committee for their technical assistance, insightful suggestions and critical review of this article.

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