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Physicochemical Characteristics of Cashew Nut Variety M23 (Anacardium Occidental L.) Grown in Cambodia

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ABSTRACT

The cashew (*Anacardium occidentale* L.) has become one of Cambodia's fastest-growing agricultural export commodities, contributing significantly to rural livelihoods and national income. Despite the country's favorable agroecological conditions and increasing cultivation area, particularly in Ratanakiri, Mondulkiri, Kratie, Stung Treng, Kampong Thom, and Preah Vihear provinces. The scientific data on the quality characteristics and post-harvest performance of Cambodian cashew nuts remain limited. This study aims to evaluate the physical, chemical, and nutritional quality of cashew kernels collected from these major producing provinces and to compare their performance with international standards to identify key challenges and opportunities for industry improvement.

The physicochemical characteristics content of cashew nuts studied by analyzing protein, fat, fiber and. Results shown that average nut weight varied from 6.5 g to 8.1 g, while shelling percentage ranged between 28.4% and 32.1%. The chemical composition analysis indicated that Cambodian cashew kernels contained 43.6–47.2% fat, 18.3–21.1% protein, 26.8–29.5% carbohydrates, and 2.1-2.6% ash, confirming their high nutritional value. The highest lipid content was recorded (47.2%), which correlated positively with kernel outturn, suggesting that soil fertility and microclimatic conditions influence both nut size and oil accumulation. Mineral analysis revealed that Cambodian cashew kernels are rich in magnesium (255–278 mg/100 g) and zinc (4.2–4.8 mg/100 g), comparable to global reference values. These results reinforce the potential of Cambodian cashew as a nutritionally valuable and export-grade product. However, the study identified several constraints affecting overall quality consistency. Postharvest drying practices were found to be highly variable, with limited access to mechanized dryers and heavy reliance on sun drying, which often exposes nuts to moisture fluctuations and contamination.

In conclusion, Cambodia possesses substantial potential to become a competitive cashew exporter in Southeast Asia, provided that improvements in post-harvest management, drying technology, and quality standardization are prioritized. Establishing cooperative-based drying and grading centers, supported by government and private partnerships, would significantly enhance quality control and export value. The findings of this study provide a scientific basis for policymakers, processors, and exporters to design targeted interventions that enhance the sustainability and profitability of the Cambodian cashew industry while ensuring product quality that meets international market demands.

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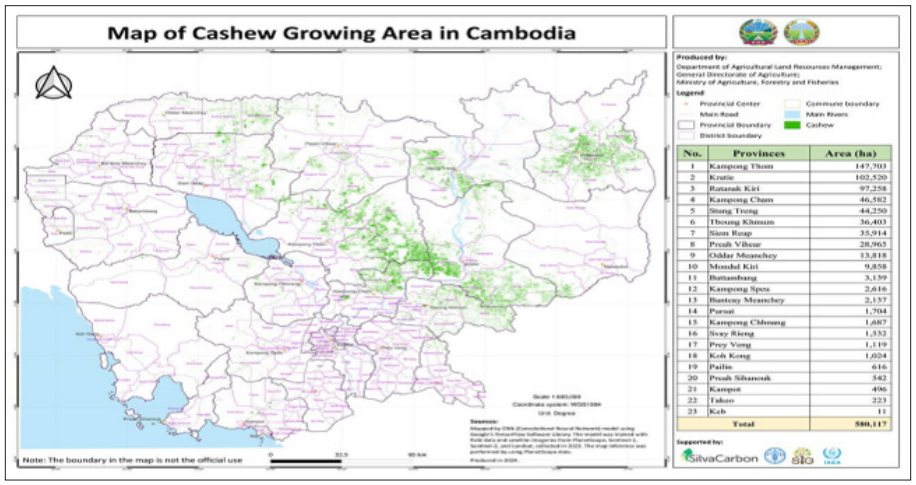
Introduction

Cashew (Anacardium occidentale L.) is a high-value tropical tree crop belonging to the family Anacardiaceae, cultivating and processing have gained significant attention in Cambodia due to the crop's high economic value. Cambodian people grow cashew trees around their homes and on available land as the crop is resilient and can thrive even in poor soil conditions. The total area of cashew plantations spans approximately 580,117 hectares, constituting a significant percentage of the country's total area. The most productive top ten provinces identified are Kampong Thom (14,250 hectares), Kratie (102,520 hectares), Ratanak Kiri (97,258 hectares, Kampong Cham (46,582 hectares), Stung Treng (44,250 hectares), Tboung Khmum (36,403 hectares), Siemreap (35,914 hectares), Preah Vihear (28,965 hectares), Oddar Meanchey (13,818 hectares), Mondul Kiri (9,859 hectares) as shown in Figure 1.



No.	Provinces	Area (ha)
1	Kampong Thom	147,703
2	Kratie	102,520
3	Ratanak Kiri	97,258
4	Kampong Cham	46,582
5	Stung Treng	44,250
6	Preang Khmum	36,403
7	Siem Reap	35,914
8	Preah Vihear	28,963
9	Oddar Meanchey	13,818
10	Mondul Kiri	9,858
11	Battambang	3,139
12	Kampong Speu	2,616
13	Banteay Meanchey	2,137
14	Pursat	1,704
15	Kampong Chhnang	1,687
16	Svay Rieng	1,332
17	Prey Veng	1,119
18	Koh Kong	1,024
19	Pailin	616
20	Preah Sihanouk	543
21	Kampot	496
22	Takeo	223
23	Kep	11
	Total	580,117

Figure 1: Map of Cashew Growing Area in Cambodia

Cashew is a highly nutritious and concentrated food form, providing a substantial amount of energy. The cashew nut kernel has a pleasant flavor and taste and can be eaten raw, oil-fried and sometimes salted or sweetened with sugar [1]. It also contributes as an important source of invisible fat in the diet, being widely used in a variety of ways. There has been a growing demand for cashew in many temperate countries where the demand is increasing [2]. The nut contains an acrid compound, which is a powerful vesicant that is abrasive to the skin. The cashew shell contains 25% of this reddish brown oil, industrially known as Cashew Nut Shell Liquid (CNSL) which is a by-product of the kernel process. The kernel is considered to be of high nutritive quality and growing conditions or the variety of cashew may have an influence on kernel composition [3]. The overall composition of the kernel is protein 21%, fat 46% and carbohydrates 25%. Quality of cashew kernels is a critical determinant of market competitiveness and export pricing. Key quality parameters include kernel outturn ratio, size, color, moisture content, and the percentage of defective kernels [4].

Despite Cambodia's potential to produce high-quality cashew nuts, systematic research on the physicochemical quality characteristics of locally grown cashew is still limited. Most prior studies have focused on yield performance and plantation management rather than on post-harvest quality and compositional attributes. For instance, studies from neighboring Vietnam reported that kernel yield, oil content, and flavor stability were highly influenced by cultivar type and post-harvest drying conditions [5]. From a nutritional perspective, cashew nuts are recognized for their high content of unsaturated fatty acids, proteins, vitamins, and essential minerals such as magnesium, zinc, and phosphorus [6]. These attributes position cashews as a key component in global healthy diet trends. However, compositional variations due to genetic, environmental, and post-harvest factors can influence both the quality and stability of the kernels. Investigating the nutritional composition of Cambodian cashews can thus provide scientific evidence to support product branding and market diversification.

This research contributes to bridging the current knowledge gap by providing baseline data on Cambodian cashew quality at the provincial level. Findings from this study are expected to assist policymakers, investors, and cooperatives in designing evidence-based strategies for improving processing efficiency, quality control, and export competitiveness.

Materials and Methods

Source of Raw Material

Cashew nuts were collected from Kampong Thom and Kratie provinces. The raw sample of cashew nut is the M23 variety. The samples were stored in room temperature for analysis. Raw samples were prepared by steaming the raw cashew nuts to facilitate peeling; these peeled kernels were then collected for analysis. The cashew nut kernels were processed to other taste flavor. Table 2.1. show the source of the sample for analysis.

Table 1: Source of Cashew Nut Samples

No.	Items	Parameters Analysis
1.	Variety M23	Parameters of testing in Table 2.
2.	Raw Cashew nut	
3.	Kernels cashew nut	
4.	Roasted salted nut	
5.	Roasted salted nut with testa	
6.	Wasabi flavor	
7.	Palm sugar	
8.	Pepper	
9.	Ingredient	
10.	BBQ flavor	

Physio-Chemical Analysis

The samples were tested by a laboratory that is accredited under ISO/IEC 17025:2017 by the international accreditation service (Accreditation ref.: 1107). The specific testing methods employed are shown in Table 2.2.

Table 2: Specific Testing Methods

No.	Parameters	Testing Method	No.	Parameters	Testing Method
1.	Moisture content	AOAC 935.29	22.	Vitamin B7 (Biotin)	ISO 20631:2024
2.	Total carbohydrate (Digestible)	AOAC 982.14	23.	Vitamin B3 (Niacine)	ISO 21470:2020
3.	Dietary fiber	AOAC 985.29	24.	Vitamin B5 (Pantothenate)	ISO 20639:2015
4.	Protein	AOAC 960.52	25.	Vitamin C (ascorbic acid)	ISO 20635:2018
5.	Oil content	AOAC 920.39	26.	Water activity (aW)	AOAC 985.26
6.	Ash (Minerals)	AOAC 942.05	27.	Calcium (Ca)	AOAC 984.27
7.	Energy	Calorimetric (Benedict,1924)	28.	Magnesium (Mg)	AOAC 984.27
8.	Palmitic acid	AOAC 996.06	29.	Potassium (K)	AOAC 984.27
9.	Stearic acid	AOAC 996.06	30.	Sodium (Na)	AOAC 984.27
10.	Linoleic acid	AOAC 996.06	31.	Copper (Cu)	AOAC 984.27
11.	Oleic acid	AOAC 996.06	32.	Iron (Fe)	AOAC 984.27
12.	Leucine	Sorensen, 1926	33.	Zinc (Zn)	AOAC 984.27
13.	Isoleucine	Sorensen, 1926	34.	Manganese (Mn)	AOAC 984.27
14.	Valine	Sorensen, 1926	35.	Selenium (Se)	AOAC 984.27
15.	Lysine	Sorensen, 1926	36.	Microbiological Load	
				- Total Plate Count	- ISO 4833-1:2013
				- Coliform	- ISO 4831.2006
				- E.coli	- ISO 7251:2005
				- Staphylococcus aureus	- ISO 6888-2:2021
				- Total yeasts	- ISO 21527-1:2008
				- Total Molds	
16.	Glutamic acid	Sorensen, 1926	37.	Pesticide	LC/MS/GC/MS
17.	Aspartic acid	Sorensen, 1926	38.	Monounsaturated Fatty acid	AOAC 996.06
18.	Arginine	Sorensen, 1926	39.	Polyunsaturated fatty acid	AOAC 996.06
19.	Vitamin E (Tocopherol α, β, δ, and γ)	ISO 20633:2015	40.	Saturated fatty acid	AOAC 996.06
20.	Vitamin K (K1: phylloquinone, K2: menaquinone and K3: menaphthone)	ISO 21446:2019	41.	Trans fatty acid	AOAC 996.06
21.	Vitamin B1 (Thiamine)	ISO 21470:2020			

Results and Discussion

Raw Cashew Nuts

Table 3: The Nutritional Composition of Raw Cashew Nuts

No.	Parameters	Results	No.	Parameters	Results
1.	Moisture content (g/100g)	4.71	19.	Vitamin E (mg/100gDW)	2.71
2.	Total carbohydrate (Digestible) (g/100gDW)	25.6	20.	Vitamin K (µg/100gDW)	30.1
3.	Dietary fiber (g/100gDW)	15.2	21.	Vitamin B1 (mg/100gDW)	0.57
4.	Protein (g/100gDW)	16.1	22.	Vitamin B7 (µg/100gDW)	6.56
5.	Oil content (g/100gDW)	39.8	23.	Vitamin B3 (mg/100gDW)	0.84
6.	Ash (Minerals) (g/100gDW)	2.80	24.	Vitamin B5 (mg/100gDW)	1.07
7.	Energy (Kcal/100gDW)	516	25.	Vitamin C (mg/100gDW)	0.38
8.	Palmitic acid (g/100gDW)	4.38	26.	Water activity (aW)	0.46

9.	Stearic acid (g/100gDW)	5.54	27.	Calcium (mg/100gDW)	165
10.	Linoleic acid (g/100gDW)	8.71	28.	Magnesium (mg/100gDW)	134
11.	Oleic acid (g/100gDW)	28.2	29.	Potassium (mg/100gDW)	645
12.	Leucine (g/100gDW)	1.44	30.	Sodium (mg/100gDW)	380
13.	Isoleucine (g/100gDW)	0.72	31.	Copper (mg/100gDW)	1.99
14	Valine (g/100gDW)	1.01	32.	Iron (mg/100gDW)	0.26
15.	Lysine (g/100gDW)	1.0	33.	Zinc (mg/100gDW)	6.15
16.	Glutamic acid (g/100gDW)	4.46	34.	Manganese (mg/100gDW)	0.03
17.	Aspartic acid	1.83	35.	Selenium (µg/100gDW)	5.25
18	Arginine (g/100gDW)	2.08	36.	Microbiological Property	-
19.	Vitamin E (mg/100gDW)	2.71	37.	Pesticide	-

The nutritional composition of Raw cashew nuts shown in Table 3.1. Griffin and Dean studied the nutritional composition of cashew nuts in raw, dry-roasted, and skin-on [7]. The results of the study shown that raw cashew nuts with skin-on contain 2.50% moisture, 44.9% fat, 28.3% carbohydrates, and 15.3% protein.

The amino acid profile, the amounts were as follows: aspartic acid 1.38 g/100 g, glutamic acid 3.19 g/100 g, lysine 0.56 g/100 g, arginine 1.6 g/100 g, leucine 1.01 g/100 g, isoleucine 0.60 g/100 g, and valine 0.77 g/100 g. fatty acid profile, the amounts were as follows: palmitic acid 10.4%, linoleic acid 17.2%, oleic acid 61.3%, and stearic acid 9.2%. Regarding vitamin profile, the amounts were as follows: vitamin B1 0.048 mg/100 g, vitamin B3 0.58 mg/100 g, vitamin K 13.7 µg/100 g, and vitamin E 95.9 µg/100 g. As for mineral profile, the amounts were as follows: potassium 0.75 (wt.%), calcium 0.06 (wt.%), magnesium 0.25 (wt.%), sodium 0.71 (wt.%), iron 78.9 mg/kg, copper 19.63 mg/kg, manganese 20.5 mg/kg, and zinc 59.7 mg/kg.

Therefore, the nutritional composition of raw cashew nuts is approximately similar to the findings reported by the above-mentioned researchers.

Steamed Cashew Nuts

Table 4: The Nutritional Composition of Steamed Cashew Nuts

No.	Parameters	Results	No.	Parameters	Results
1.	Moisture content (g/100g)	5.22	20.	Vitamin K (µg/100gDW)	26.2
2.	Total carbohydrate (Digestible) (g/100gDW)	24.5	21.	Vitamin B1 (mg/100gDW)	0.57
3.	Dietary fiber (g/100gDW)	16.2	22.	Vitamin B7 (µg/100gDW)	4.73
4.	Protein (g/100gDW)	15.2	23.	Vitamin B3 (mg/100gDW)	0.78
5.	Oil content (g/100gDW)	41.0	24.	Vitamin B5 (mg/100gDW)	1.04
6.	Ash (Minerals) (g/100gDW)	2.47	25.	Vitamin C (mg/100gDW)	0.52
7.	Energy (Kcal/100gDW)	520	26.	Water activity (aW)	0.48
8.	Palmitic acid (g/100gDW)	4.53	27.	Calcium (mg/100gDW)	161
9.	Stearic acid (g/100gDW)	5.47	28.	Magnesium (mg/100gDW)	134
10.	Linoleic acid (g/100gDW)	7.97	29.	Potassium (mg/100gDW)	632
11.	Oleic acid (g/100gDW)	27.10	30.	Sodium (mg/100gDW)	379
12.	Leucine (g/100gDW)	1.37	31.	Copper (mg/100gDW)	1.71
13.	Isoleucine (g/100gDW)	0.7	32.	Iron (mg/100gDW)	0.24
14.	Valine (g/100gDW)	0.98	33.	Zinc (mg/100gDW)	5.13
15.	Lysine (g/100gDW)	0.95	34.	Manganese (mg/100gDW)	0.03
16.	Glutamic acid (g/100gDW)	4.21	35.	Selenium (µg/100gDW)	5.25
17.	Aspartic acid	1.75	36.	Microbiological Property	-
18.	Arginine (g/100gDW)	1.99	37.	Pesticide	-
19.	Vitamin E (mg/100gDW)	2.27			

The nutritional composition of Steamed cashew nuts presented in Table 3.2. investigated the effect of steaming duration and drying temperature on the chemical properties of cashew nuts [8]. Their findings indicated that the moisture content ranged between 4.16% and 5.03%. Similarly, examined the effect of processing treatments on the nutritional characteristics of cashew kernels (Anacardium occidentale L.) from three localities in Burkina Faso [9]. The study reported that the moisture content ranged from 5.03% to 5.43%, total ash content from 2.70% to 2.92%, protein content from 25.44 g to 30.11 g, fat content from 42.26 g to 43.13 g, and carbohydrate content from 8.22 g to 11.59 g. The total energy value of the kernels was found to range from 515.05 to 554.93 kcal per 100 g.

Therefore, the nutritional composition of Steamed cashew nuts is approximately similar to the findings reported by the above-mentioned researchers.

Steamed Cashew Nuts After 10 months of Storage

Table 5: The Nutritional Composition of Steamed Cashew Nuts After 10months of Storage

No.	Parameters	Results	No.	Parameters	Results
1.	Moisture content (g/100g)	3.33	12.	Lysine (g/100g)	0.68
2.	Total carbohydrate (Digestible) (g/100g)	25.34	13.	Valine (g/100g)	0.59
3.	Dietary fiber (g/100g)	17.49	14.	Vitamin B1 (mg/100g)	0.48
4.	Protein (g/100g)	21.55	15.	Vitamin B3 (mgNE/100g)	1.70
5.	Oil content (g/100g)	30.03	16.	Vitamin B5 (mg/100g)	0.45
6.	Ash (Minerals) (g/100g)	2.26	17.	Vitamin B7 (µg/100g)	12.1
7.	Energy (Kcal/100g)	527.79	18.	Vitamin E (mgTE/100g)	0.22
8.	Monounsaturated Fatty acid (g/100g)	17.0	19.	Vitamin K (µg/100g)	6.11
9.	Polyunsaturated fatty acid (g/100g)	5.02	20.	Vitamin C (mg/100g)	<0.01
10.	Saturated fatty acid (g/100g)	6.66	21.	Water activity (aW)	0.498
11.	Trans fatty acid (g/100g)	0.01			

After steaming, cashew nuts retain a higher moisture content, making them susceptible to microbial growth and enzymatic activity. Drying after steaming is therefore a critical step to reduce moisture to safe storage levels and improve shelf life. The duration and conditions of drying significantly influence the nutritional and physicochemical quality of the nuts shown the results in Table 3.3.

Moisture content decreases progressively with longer drying times. Proper drying reduces water activity, limiting microbial proliferation and enzymatic degradation, which is essential to maintain kernel integrity during storage [8]. Lipid content and stability are affected by drying after steaming. While drying removes moisture, it can also slightly accelerate oxidation if conducted at high temperatures or for excessive durations. Controlled drying preserves unsaturated fatty acids and limits rancidity, maintaining the sensory and nutritional quality of cashew nuts [10]. Proteins and carbohydrates are relatively stable during post-steaming drying. The amino acid profile and carbohydrate fractions show minimal changes, indicating that macronutrient composition is largely unaffected by typical drying durations. Vitamins and minerals exhibit differential stability. Fat-soluble vitamins, such as vitamin E, may decrease slightly due to heat exposure, while minerals, including calcium, magnesium, and potassium, remain largely unaffected [11].

Overall, drying after steaming primarily influences moisture content and lipid stability, with minor effects on proteins, carbohydrates, and minerals. Optimizing drying conditions-moderate temperature and appropriate duration-is essential to preserve the nutritional quality and shelf life of steamed cashew nuts.

Cashew Kernels

Table 6: The Nutritional Composition of Cashew Kernels

No.	Parameters	Results	No.	Parameters	Results
1.	Dietary fiber (g/100g)	4.61	22.	Zinc (Zn) (mg/kg)	33.0
2.	Total sugars (g/100g)	8.04	23.	Copper (Cu) (mg/kg)	13.5
3.	Fat (g/100g)	47.4	24.	Iron (Fe) (mg/kg)	56.1
4.	Protein (g/100g)	16.6	25.	Cadmium (mg/kg)	-
5.	Ash (g/100g)	2.58	26.	Lead (Pb) (mg/kg)	-
6.	Sucrose (g/100g)	8.04	27.	Arsenic (As) (mg/kg)	-
7.	Fructose (g/100g)	-	28.	Mercury (Hg) (mg/kg)	-
8.	Vitamin A (Retinol) (IU/100g)	-	29.	Carbohydrates (excluding Dietary fiber) (g/100g)	24.9
9.	Vitamin B12 (µg/100g)	-	30.	Energy value (calculated according to carbohydrates excluding Dietary fiber) (Kcal/100g)	602
10.	Saturated fatty acids (g/100g)	11.0	31.	Nickel (Ni) (mg/kg)	6.35
11.	Monounsaturated fatty acids (g/100g)	28.0	32.	Starch (g/100g)	12.6
12.	Polyunsaturated fatty acids (g/100g)	8.34	33.	Vitamin B2 (Riboflavin) (mg/100g)	-
13.	Cholesterol (mg/kg)	-	34.	Vitamin B3 (as Niacin) (mg/100g)	1.30

14.	Lactose (g/100g)	-	35.	Vitamin B5 (acid pantothenic) (mg/100g)	0.55
15.	Maltose (g/100g)	-	36.	Vitamin B6 (Pyridoxine) (mg/100g)	0.049
16.	Glucose (g/100g)	-	37.	Vitamin B9 (µg/kg)	-
17.	Calcium (mg/kg)	175	38.	Vitamin E (Alpha-tocopherol) (mg/100g)	0.19
18.	Magnesium (mg/kg)	1990	39.	Delta-Tocopherol (mg/100g)	0.25
19.	Phosphorus (P) (g/100g)	0.39	40.	Manganese (Mn) (mg/kg)	21.8
20.	Potassium (K) (mg/kg)	7320	41.	Selenium (Se) (mg/kg)	0.13
21.	Sodium (Na) (mg/kg)	64.2			

The nutritional composition of Cashew kernels reported in Table 3.4. reported that the moisture content of fresh cashew nuts ranged from 2.3 to 5.3 g/100 g [12]. The protein content was between 20.1 and 23.0 g/100 g, while the total ash content ranged from 2.4 to 2.8 g/100 g. Sodium levels ranged from 120 to 205 mg/kg, fiber content was between 3.2 and 3.9 g/100 g, and carbohydrate content ranged from 18.1 to 23.6 g/100 g. The energy value was reported between 591 and 618 kcal/100 g.

The fatty acid profile shown saturated fatty acids ranging from 16.95 to 22.30%, monounsaturated fatty acids from 60.20 to 65.40%, and polyunsaturated fatty acids from 16.75 to 19.30%. Cholesterol levels ranged from 0.4 to 0.6 mg/100 g. Vitamin contents included vitamin B2 (0.020–0.034 mg/100 g), vitamin B5 (0.519–1.120 mg/100 g), vitamin B9 (33.400–45.200 µg/100 g), vitamin E (0.289-0.850 mg/100 g), vitamin B6 (0.255–0.511 mg/100 g), and vitamin B3 (1.140–1.530 mg/100 g).

In terms of minerals, iron ranged from 4.5 to 7.1 mg/100 g, zinc from 4.9 to 5.9 mg/100 g, sodium from 6.6 to 14.0 mg/100 g, potassium from 540 to 670 mg/100 g, magnesium from 240 to 265 mg/100 g, calcium from 28 to 52 mg/100 g, and phosphorus from 460 to 570 mg/100 g.

Studied the nutritional and bioactive constituents, functional activities, and industrial applications of cashew (Anacardium occidentale L.) [13]. Their results shown that cashew nuts contained 574 kcal, 15.31 g/100 g protein, 9.157% saturated fatty acids, 27.317% monounsaturated fatty acids, 7.836% polyunsaturated fatty acids, and 3 g/100 g fiber. Additionally, vitamin B2 content was 402 µg/100 g, vitamin B6 was 306 µg/100 g, and tocopherol was 15.5 µg/100 g oil.

Investigated the nutritional and physicochemical characteristics of cashew nuts (Anacardium occidentale L.) grown in Pawe District, Northwestern Ethiopia [14]. Their findings indicated that moisture content ranged from 5.84 to 6%, ash content from 2.53 to 2.76%, protein from 24.76 to 26.22%, fat from 48.50 to 50.19%, fiber from 2.49 to 2.56%, and carbohydrate from 13.97 to 14.20%.

The mineral composition revealed sodium levels between 7.88 and 8.16 mg/100 g, potassium 27.50–29.08 mg/100 g, phosphorus 13.65–13.71 mg/100 g, calcium 21.25–21.45 mg/100 g, magnesium 32.73–33.31 mg/100 g, zinc 0.85–0.89 mg/100 g, and iron 0.69–0.71 mg/100 g.

Therefore, the nutritional composition of Cashew kernels is approximately similar to the findings reported by the above-mentioned researchers.

Kernels Cashew Nut Added Flavor/Taste

Table 7: Table Showing the Nutritional Composition of Kernels Cashew Nut Added Flavor/Taste

No	Parameter	Roasted with testa	Wasabi taste	Palm sugar taste	Pepper taste	BBQ taste	Mix ingredients taste
1	Dietary Fiber (g/100g)	9.72	3.87	4.80	5.01	4.09	4.21
2	Fat (g/100g)	35.37	41.9	44.80	43.60	42.40	42.80
3	Protein (g/100g)	21.28	15.5	16.0	15.60	17.90	18.20
4	Ash (g/100g)	2.6	3.34	2.51	2.98	3.22	2.80
5	Calcium (Ca) (mg/kg)	170	243	227	225	290	213
6	Magnesium (Mg/kg)	100	1860	2020	1960	2010	2040
7	Phosphorus (p) (mg/kg)	3978	3840	3580	3780	5500	4450
8	Potassium (K) (mg/kg)	5842	7280	7570	7750	7880	7090
9	Sodium (Na) (mg/kg)	1796	4520	824	2810	4910	2130
10	Iron (Fe) (mg/kg)	13.5	55.1	55.6	54.6	52.4	46.9

11	Cabohydrates (excluding Dietary fiber) (g/100g)	38.71	33.9	30.5	31.5	30.10	30.30
12	Energy value (including Dietary fiber) (Kcal/100g)	558.29	582	599	591	582	588
13	Moisture and volatile matter content (%)	2.04	1.50	1.40	1.27	2.28	1.68

Table showing the nutritional composition of Kernels Cashew nut added flavor/taste shown in Table 3.5. investigated the nutritional composition of cashew nuts in raw, dry-roasted, and skin-on forms [7]. The results indicated that phosphorus content was 0.60 wt.%, potassium 0.75 wt.%, calcium 0.05 wt.%, magnesium 0.30 wt.%, sodium 0.30 wt.%, and iron 70.3 mg/kg.

Studied the effects of flavor coating on cashew kernels [15]. Cashew nuts coated with black pepper had moisture 2%, protein 23.22%, fat 44.10%, carbohydrate 26.82%, fiber 1.72%, phosphorus 0.56%, potassium 0.34%, and magnesium 0.33%. Cashew nuts coated with chili had moisture 2.64%, protein 23.33%, fat 44.40%, carbohydrate 25.37%, fiber 1.38%, phosphorus 0.60%, potassium 0.35%, and magnesium 0.27%. Honey-coated cashew nuts had moisture 2.67%, protein 22.28%, fat 43.28%, carbohydrate 28.23%, fiber 1.30%, phosphorus 0.47%, potassium 0.31%, and magnesium 0.29%. Salt-coated cashew nuts had moisture 2%, protein 21.12%, fat 43.20%, carbohydrate 25.85%, fiber 1.27%, phosphorus 0.56%, potassium 0.31%, and magnesium 0.29%.

Conducted research on the standardization of flavor coatings in cashew kernels [16]. Cashew nuts coated with green chili had moisture 2%, protein 21%, fat 44.15%, carbohydrate 26.24%, fiber 1.27%, and ash 2.67%. Cashew nuts coated with tangy tomato flavor had moisture 2.33%, protein 21.43%, fat 43.37%, carbohydrate 28.9%, fiber 1.30%, and ash 1.48%.

Performed a comparative quality evaluation of oven-roasted and honey-coated cashew nuts (Anacardium occidentale L.) produced using a locally fabricated processing machine in Nigeria [17]. Roasted cashew nuts contained protein 17.37%, fat 43.28%, fiber 1.38%, ash 1.38%, moisture 7.58%, energy 2148.94 kJ/100 g, sodium 880 mg/100 g, potassium 780 mg/100 g, phosphorus 147 mg/100 g, iron 20.80 mg/100 g, calcium 4470 mg/100 g, and magnesium 650 mg/100 g. Honey-coated cashew nuts contained protein 18.25%, fat 43.66%, fiber 2.27%, ash 2.53%, moisture 6.04%, energy 2157.2 kJ/100 g, sodium 770 mg/100 g, potassium 710 mg/100 g, phosphorus 207 mg/100 g, iron 19.70 mg/100 g, calcium 3780 mg/100 g, and magnesium 530 mg/100 g.

Therefore, the nutritional composition of Kernels Cashew nut added flavor/taste is approximately similar to the findings reported by the above-mentioned researchers.

Conclusion

The study comprehensively evaluated the physicochemical and nutritional characteristics of cashew nuts (Anacardium occidentale L.) grown in Cambodia, focusing on raw, steamed, stored, and flavored kernels. The study confirms that Cambodian cashew nuts are rich in protein, oil, fiber, and essential minerals, with stable physicochemical properties across processing methods and storage. The findings indicate that cashew nuts from Cambodia possess High Nutritional and Commercial Potential, suitable for both local consumption and international markets, with the following key findings:

- Raw cashew kernels contained 16.1 g/100 g protein, 39.8 g/100 g oil, 15.2 g/100 g dietary fiber, and 2.80 g/100 g ash, with an energy value of 516 kcal/100 g. The kernels also exhibited high levels of unsaturated fatty acids, primarily oleic acid (28.2 g/100 g) and linoleic acid (8.71 g/100 g), indicating their potential as a healthy lipid source. Mineral analysis shown potassium (645 mg/100 g), calcium (165 mg/100 g), and magnesium (134 mg/100 g), supporting their nutritional value.
- Steamed cashew nuts retained similar nutritional quality, with protein (15.2 g/100 g) and oil (41.0 g/100 g), while moisture slightly increased to 5.22%, which is consistent with literature indicating that moisture rises during steaming. The steaming process slightly reduced vitamin content (e.g., vitamin E: 2.27 mg/100 g) but preserved macronutrient composition.
- Steamed cashew nuts after 10 months of storage shown a decrease in moisture content (3.33%), a slight reduction in fat (30.03 g/100 g), and an increase in protein (21.55 g/100 g) and fiber (17.49 g/100 g), indicating that proper storage maintains kernel stability while concentrating some macronutrients. Vitamins such as B3 and B7 increased during storage, whereas vitamin E and K decreased, highlighting differential vitamin stability over time.
- Cashew kernels demonstrated high energy density (602 kcal/100 g), and substantial mineral content, with magnesium (1990 mg/kg), potassium (7320 mg/kg), zinc (33 mg/kg), and iron (56.1 mg/kg), emphasizing their potential contribution to micronutrient intake. Fatty acid composition was dominated by monounsaturated fatty acids (28.0 g/100 g), followed by polyunsaturated (8.34 g/100 g) and saturated fats (11.0 g/100 g), supporting cardiovascular health.
- Kernels with added flavors/tastes (roasted, wasabi, palm sugar, pepper, BBQ, mixed ingredients) maintained high energy values (558–599 kcal/100 g), moderate fat (35–44.8 g/100 g), and protein (15.5–21.28 g/100 g). Mineral contents, especially magnesium (100–2040 mg/kg), potassium (5842–7880 mg/kg), and iron (13.5–55.6 mg/kg), varied depending on flavor additives, suggesting that coating and seasoning processes can modify mineral availability slightly but do not compromise macronutrient content.

To sum up, Cambodian cashew kernels revealed excellent nutritional value, high energy content, favorable fatty acid composition, and substantial mineral content, and the post-harvest processing methods (steaming, storage, flavoring) can be optimized to maintain quality, extend shelf life, and enhance marketability. These results provide a scientific basis for promoting Cambodian cashew nuts as a high-value food product with both domestic and export potential.

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