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Nutrient Evaluation and Phytochemical Analysis of Fresh and Dry Leaves of *Carica papaya*

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ABSTRACT

Background: The relative abundance and all year availability of *Carica papaya* necessitated this study and the availability of these leaves in almost all regions of the world.

Methods: Air-dried and fresh *Carica papaya* leaves were collected for comparative analysis to investigate the proximate constituent, minerals, vitamins and presence of phytochemicals. The analyses were investigated in accordance with standard procedures.

Result: The results of proximate showed that the fresh leaves contained higher level of crude fat, ash, crude fiber and crude protein when compared with the dry leaves. However, the dry leaves have higher percentages of calcium, sodium and phosphorus when compared with the fresh leaves. The fresh leaves shows higher levels of vitamins, (mg/100 g) ascorbic acid (C) 26.9, thiamine (B_1) 0.62, riboflavin (B_2) 0.69, however, the tocopherol (E) 48.195 content of the dry leaves was comparably higher. Phytochemical analysis revealed the presence of numerous bioactive compounds: saponin, phenol, terpene, oxalate, tannin, steroid, phytate and alkaloids. Thus, fresh pawpaw leaf gave a source of essential nutrients while dry pawpaw leaf was a source of calcium, sodium and phosphorus. Therefore, pawpaw leaves can be manipulated in the herbal treatment of various diseases and a potential source of useful elements for drugs formulation.

Key words: Mineral, Papaya leaves, Phytochemical, Proximate analysis, Vitamin.

INTRODUCTION

Medicinal plants are endowed with several biologically active compounds which possess potent antimicrobial activity which could be used to effectively replace synthetic chemicals. Antibiotics are banned in medical field due to emergence of resistance strains of pathogens. Development of resistant strains has heralded search for recent, effective, economical and easily available sources such as medicinal herbs: medicinal herbs are age old sources of drugs (Alabi *et al*., 2012). Various active compounds mainly secondary metabolites are synthesized by medicinal herbs and these secondary metabolites are mainly responsible for antimicrobial property. These pharmacologically active substances singly or in combination with other inactive substances act as reservoir of antimicrobial agent and the active compounds are responsible for their characteristic odour, pungencies and colours of plants while others give a particular plant its culinary, medicinal or poisonous virtues (Evans and Trease, 2002). The antimicrobial agents are not only potent against infectious diseases, but also mitigate the adverse effect of synthetic antimicrobial agents (Iwu and Duncan, 1999).

Carica papaya is an herbaceous plant whose fruits, leaves, seeds and latex are used medicinally. The fruit has a juicy taste rich in antioxidant nutrients like carotene, vitamin C, vitamin B complex, flavonoids, folate and minerals such as potassium and magnesium. The leaves, stem and fruits contain these biological enzymes chymopain and papain (Dick, 2003; Barger *et al*., 2009). Every part of *Carica papaya* is of economic value and its use ranged from nutritional to medicinal. Dry leaves of papaya are often wasted since it is assume that it is not beneficial but used to enrich the soil.

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The chemical composition of a plant is of utmost importance from many standpoints, including nutrition and health, toxicology and safety and stability to microbiological, chemical or physical changes. The objective of this study is to compare the phytochemical and nutrient contents of dry and fresh *Carica papaya* leaves. This finding will be very helpful and useful on the ground of health and economic importance in different sectors as fresh and dry leaves of this plant are often wasted because of lack of adequate knowledge of the potential inherent in them.

MATERIALS AND METHODS

Collection and identification of plant material

Fresh healthy, mature–leaves of *Carica papaya* were handpicked from Babcock University, Ilishan Remo, Ogun State. The plant was identified and authenticated by Agronomist from the Department of Agriculture and Industrial Technology of Babcock University, Ilishan Remo.

Leaf meal preparation

Harvesting of fresh leaves was done between the hours of 16:00 and 17:00 when the plants must have completed their light stage of photosynthetic process for the day. Leaves were air dried at an average room temperature of 27°C for seven days and then milled with a hammer mill using sieve of 0.02 mm pore size to obtain a fine powdery dust. The powdered test samples were stored in a dry, clean container with lid for further analysis. Fresh leaves were also harvested for analysis.

Proximate analysis

The moisture content was determined by drying at 105°C in an oven until a constant weight was reached. For total ash determination, the leaves samples were weighed and converted to dry ash in a muffle furnace at 450 and at 550°C for incineration. The crude fat content was determined by extraction with hexane, using a Soxhlet apparatus. All these determinations were carried out according to AOAC, (1990). Kjeldahl method was used for crude protein determination. Carbohydrate content was determined by calculating the difference between the sums of all the proximate compositions from 100%.

Minerals analysis

Mineral analyses were carried out according to Martin-Prevel *et al.,* (1984). Elemental analyses were carried out using an atomic absorption spectrophotometer and flame photometer to determine calcium, sodium, potassium and magnesium content. Iron, copper and zinc were determined calorimetrically. The concentration of each element in the leaves sample was calculated on a dry matter basis.

Vitamin analysis

To determine the water soluble vitamins, standards were prepared by accurately weighing 10 to 20 mg of the vitamin powder and 10 to 20 ml of distilled water was added to make stock solutions of 1.0 mg/mL for each vitamin.

For sample preparation

0.100 g of accurately weighed *papaya* leaf meal was transferred into 100 ml volumetric flasks; then 80 ml of water was added to each flask. After 15 minutes of ultrasonic extraction, water was added to the mark and filter through 0.45 um membrane filter.

Phytochemical analysis

Phytochemical analysis was conducted to determine the presence of phytate, saponin, flavonoid, tannin and alkaloid while the quantification of saponin was done by afrosimetric method (Koziol, 1991). The gravimetric method (Harborne, 1973) was used in determination of alkaloid and flavonoid contents. All the analyses were done using triplicate samples.

Statistical analysis

All the data were subjected to analysis of variance (ANOVA) using Statistical Package for Social Sciences version 17.0 for windows, SPSS Inc. Means were separated using Duncan Multiple Range Test where significant.

RESULTS AND DISCUSSION

Table 1 showed the results of proximate analysis of the dry and fresh leaves of *Carica papaya*. The results revealed that the dry and fresh leaves of *Carica papaya* contained appreciable amounts of crude fat (8.750 and 8.850% respectively), ash content (5.200 and 5.800% respectively) and crude fibre (5.700 and 8.950% respectively) but low amounts of crude protein (8.190 and 9.150% respectively).

The present finding of crude protein (CP) value are lower than the reported values of 30.120 per cent (Onyimonyi and Onu, 2009), 28.200 per cent (Ebenebe *et al.*, 2011) and 23.300 per cent (Machoko *et al.*, 2019) in papaya leaves, but close to the values of 8.900 and 8.630 per cent for unripe and ripe seeds of *Carica papaya* respectively (Akintunde *et al.,* 2021 and Kolu *et al.*, 2021). This could be due to differences in soil, season, or location. Because the fresh and dry leaves of *Carica papaya* are low in protein, it will need to be supplemented with protein if it is to be used in the diet of monogastric animals.

The crude fibre (CF) content of 5.700 and 8.950 percent of dry and fresh *Carica papaya* leaves is higher than 5.600 percent revealed by (Onyimonyi and Onu, 2009). But, it was lower than CF content found in unripe seed of *Carica papaya* (23.200%) and sun-dried seeds of ripe *Carica papaya* (28.300%) (Akintunde *et al.*, 2021; Kolu *et al.*, 2021). Because of its low crude fiber content, this leaf could be used as a monogastric feed ingredient.

However, the ash percentage of 5.200 and 5.800 percent in dried and fresh *Carica papaya* leaves is lower than that of some Nigerian leaves, such as sweet potato leaves, which have an ash value of 11 per cent (Antia *et al.*, 2006). It's also lower than Akintunde *et al.,* (2021) and Kolu *et al.,* (2021) reported for unripe (8.650%) and ripe (11.200%) *Carica papaya* seeds. Its relatively high content reflects the mineral materials it has deposited.

Table 2 revealed some mineral content of pawpaw leaves. The dry and fresh leaves of *Carica papaya* contained essential minerals: Calcium (1.200 and 1.0735%), Potassium (0.241 and 0.258%), Sodium (0.0245 and 0.001%) and Phosphorus (0.104 and 0.000%) respectively.

Table 1: Proximate analysis of fresh and dry *Carica papaya* leaves.

Sample	% Dry matter	% Moisture contents	% Ash	% Crude fat	% Crude fiber	% Crude protein
Dry	94.20	5.80	5.20	8.75	5.70	8.19
Fresh	93.55	6.45	5.80	8.85	8.95	9.15
SEM	0.24	0.24	0.18	0.09	0.94	0.31

The minerals contents of the dry and fresh leaves of *Carica papaya* fruits are however significantly different ($p<0.05$) from each other.

The mineral composition revealed that *Carica papaya* leaves are a significant source of mineral elements. According to the results of this study, the dry leaves of pawpaw, which are generally dismissed as nutritionally useless, contain higher levels of Ca, Na and P than the fresh leaves. When the usefulness of minerals like Ca, Mg, Na, K, Fe and Mn in the *Carica papaya* leaves suggests that the leaves are useful in blood coagulation, the appropriate working of the heart and nervous system and the regular contraction of muscles, this result becomes extremely essential.

Magnesium and calcium help the body absorb phosphorus (Claude and Paule, 1979). The potassium levels in the dried and fresh leaves, on the other hand, were nearly identical. Potassium is required for the muscular weakness associated with malaria, as well as for the slowing of vascular sclerosis. It aids in the fight against bacteria and aids in the cleansing of the digestive tract. Sodium aids in water metabolism, digestion, assimilation and osmosis, as well as cleansing the digestive system, combating stomach acidity and alkalinizing the blood (Claude and Paule, 1979). It is for this reason that the brown pawpaw leaf is employed as a cleaner in herbal remedies (Atta, 1999).

Table 3 showed that the dry and fresh leaves of *Carica papaya* fruits contained vitamin B_1 (0.282 and 0.620 mg/100 g), vitamin B_2 (0.0345 and 0.0695 mg/100 g), vitamin C (19.700 and 26.900 mg/100 g) and vitamin E (48.195 and 31.675 mg/100 g). The fresh leaf samples however had significantly higher ($p<0.05$) vitamin C and B_2.

When comparing the fresh and dried leaves of *Carica papaya*, the fresh leaves have higher quantities of vitamin C, B_1 and B_2. The vitamin E content of dried leaves (48.195 mg/100 g) was higher than that of fresh leaves (31.675 mg/100 g). Ascorbic acid deficiency is linked to joint aches, a defect in skeletal calcification, anemia and scurvy hemorrhage from the mouth and gastrointestinal tract (Hunt *et al.,* 1980). This function of ascorbic acid explains why it is required for normal wound healing. Ascorbic acid also has the intriguing ability as an antioxidant, to prevent or at least reduce the production of carcinogenic chemicals from dietary material (Hunt *et al*., 1980). Other vitamins are necessary for biological metabolism, even if they are only in trace amounts (Njoku and Akumefula, 2007). Because of the presence of vitamins C and E, the leaves are also a promising for countering oxidative stress, particularly in broiler chicken production.

The phytochemical analysis of the leaves (Table 4) showed that the leaves contained flavonoids, alkaloids, saponin, tannin, phenols, terpenes and steroid. When compared to fresh leaves, the dry leaves had a larger amount of saponin, phenol, terpene, steroid and flavonoids content. The same amount (0.003 mg/100 g) of flavonoid content was observed in dried and fresh leaves in this investigation.

Table 2: Mineral of fresh and dry *Carica papaya* leaves.

Sample	% Ca	% K	% Na	% P
Dry	1.204	0.241	0.025	0.104
Fresh	1.074	0.258	0.001	0.000
SEM	0.038	0.005	0.007	0.030
	*		*	*

*($p<0.05$).

Table 3: Vitamins of fresh and dry *Carica papaya* leaves.

Sample	Vit.C (mg/100 g)	Vit.B_1 (mg/100 g)	Vit.B_2 (mg/100 g)	Vit. E (mg/100 g)
Dry	19.700	0.282	0.035	48.195
Fresh	26.900	0.620	0.069	31.675
SEM	2.079	0.114	0.010	4.774
	*		*	*

*($p<0.05$).

Table 4: Phytochemical analysis of dry and fresh *Carica papaya* leaves.

Phytochemicals (mg/100 g)	Dry	Fresh	SEM
Flavonoids	0.002	0.003	0.000
Alkaloids	0.269	0.240	0.008
Saponin	0.467	0.182	0.029
Tannins	0.004	0.005	0.001
Phenols	0.316	0.169	0.104
Terpenes	0.212	0.001	0.000
Steroid	0.174	0.002	0.000

Both the dry (0.269 mg/100 g) and fresh (0.240 mg/100 g) leaves contained comparatively similar amounts of alkaloid. The most effective therapeutically significant plant ingredient is alkaloids. Because of their analgesic, antispasmodic and antibacterial characteristics, pure isolated alkaloids and synthetic derivatives are utilized as fundamental medical agents (Stray, 1998). When given to animals, they have noticeable physiological effects.

Due to the fact that saponins are cytotoxic, the presence of saponins supports the notion that pawpaw leaf has cytotoxic effects such as intestinal permealization (Okwu and Okwu, 2004). It also imparts a bitter flavor to the leaves. Saponin interacts with sex hormones such as oxytocin. Oxytocin is a sex hormone that regulates the commencement of labor and the subsequent release of milk in women (Okwu and Okwu, 2004). Saponins also have an expectorant effect, which is mediated by the stimulation of an upper digestive tract reflex (David, 1983).

The dry and fresh leaves of pawpaw as observed from this study contain low levels of tannin (0.004 and 0.005 mg/100 g respectively). The values are lower than the values of 52.920 and 66.500 mg/100 g for sun-dried and oven-dried seeds of ripe *Carica papaya* respectively as reported by Kolu *et al.,* (2021). The values for tannin from the leaves (dry and fresh) in the present study was very much lower than the unripe seeds of *Carica* papaya (84.120 mg/100 g) as reported by Akintunde *et al.,* (2021) but closer to the 0.09%

oberved in *Moringa oleifera* seeds (Akintunde and Toye, 2014). The low levels of tannin for both the dry and fresh leaves of *Carica papaya* suggest the safety of its inclusion in monogastric animal's nutrition.

The dry (0.316 mg/100 g) leaves had a substantially higher phenolic content than the fresh (0.169 mg/100 g) leaves. When compared to flavonoids and coumarin compounds, the primary chemicals found in *C. papaya* leaves are phenolic acids and trace levels of chlorogenic acid, according to Canini *et al.,* (2007). The existence of such phenolic and coumarin chemicals in *C. papaya* leaves could partially explain the plant's pharmacological characteristics. However, this study reveals that both fresh and dry leaves of *Carica papaya* contain significant amounts of phenols, implying that they could be used as ethno-medicinal plants.

The dry (0.212 mg/100 g) pawpaw leaves have more terpenes than the fresh (0.001 mg/100 g) leaves. Terpenoids have medical qualities such as hepaticidal, anti-microbial, or diuretic (*e.g.*, glycyrrhizin) (Dudareva *et al*., 2004). In their interaction with free radicals, terpenes have a particular antioxidant function.

Pawpaw leaves, both dry and fresh, contain steroids. Steroids are most known for their ability to affect lipid metabolism (Bartnikowska, 2009). Phytosterol, a type of steroid, has anti-inflammatory properties as well as inhibiting cholesterol absorption in the intestine (Navarro *et al*., 2001; Awad *et al*., 2004). Steroids are also utilized to make medications and a variety of sex hormones. This could explain why the plant is used to treat urogenital infections and urethral discharge (Okoli *et al*., 2008), as well as false labor and threatening abortion (Orlu and Obulor, 2014). Steroids are also known for their antibacterial properties, which are linked to membrane lipids and cause leaking from liposomes (Epand *et al*., 2007).

CONCLUSION

It can be concluded that the dry and fresh leaves of *Carica papaya* have proximate, vitamins, minerals and phytochemical compositions. The results of the proximate and mineral indicated the presence of considerable amount of nutrients. The phytochemical components of the dry and fresh leaves of *Carica papaya* contain alkaloid, saponins, phenol, terpene and steroid. The presence of the phytochemicals has authenticated its usefulness for therapeutic purposes and to boost immunity in livestock.

Conflict of interest: None.

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