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Proximate, Phytochemical and Vitamin Compositions of Prosopis Aficana Stem Bark

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Abstract

The use of plants or natural products have recently gained global interest due to the increasing awareness on the dangers of synthetic drugs and chemicals in terms of its adverse affect and anticipated toxicity, plants have played vital roles in bridging the gap between food safety and livestock production; they are cheap, effective and safe due to the presence of phytochemicals or bioactive chemicals, therefore this study was carried out to examine the proximate, phytochemical and vitamin compositions of Prosopis aficana stem bark (PAD). Proximate analysis revealed the presence of moisture (8.35 %), dry matter (91.65 %), crude protein (4.87 %), crude fibre (45.60 %), ether extract (0.81 %), ash (11.52 %) and carbohydrates (28.85 %). Phytochemical screening of PAD showed that it contained hydrolysable tannins, condensed tannins, alkaloids, flavonoids, terpenoids, saponins, phenols, phytic acid and oxalates at 3.33 %, 0.17 %, 5.45 %, 9.83 %, 2.10 %, 1.82 %, 4.02 %, 0.78 % and 0.85 % respectively. PAD contained β-carotene (1.51 mg/100g), vitamin B1 (0.33 mg/100g), vitamin B2 (0.94 mg/100g), vitamin B3 (0.42 mg/100g), vitamin B6 (0.20 mg/100g), vitamin B9 (0.18 mg/100g), vitamin B12 (0.88 mg/100g), vitamin C (4.22 mg/100g), vitamin D (0.12 mg/100g) and vitamin K (0.21 mg/100g). It was concluded that PAD is loaded with nutrients and phytochemicals which confers them the ability to perform multiple biological activities and are also precursors for the synthesis of useful drugs.

Keywords: Prosopis aficana, phytochemicals, plants, proximate analysis, vitamins

INTRODUCTION

Medicinal plants are used as source of drugs for the treatment of various human and livestock health disorders all over the world from ancient times to the present day (Kavita *et al*., 2014). Medicinal plants are one of the numerous gifts of nature to man without harmful residual toxicity in the food chain (Alagbe *et al*., 2020). Out of the over 250, 000 species of medicinal plants reported by WHO (1998), very few numbers have been exploited, among the potential plant is *Prosopis aficana*.

Prosopis aficana are pod bearing trees or shrubs belonging to the family Fabaceae. The plant consists of about 44 species, which are found in arid and semi arid regions of the world (Agboola, 2004; Abah *et al*., 2018). The tree can grow up to 17 meters in height and characterized by dark rough bark, pale dropping foliage with small pointed leaflets and sausage shaped fruits, the pods on the tree do not split open when dry but can be harvested by shaking off the ripe pods from the tree branches (Ayanwuyi *et al*., 2010; Olorunmaiye *et al*., 2019; Ezike *et al*., 2010). The leaf, stem and root extract has been traditionally used for the treatment of dysentery, rheumatism, tooth ache, dermatitis, bronchitis, malaria, menstrual pain and general body pain (Mann *et al*., 2003; Ayanwuyi *et al*., 2010).

Scientific reports have revealed that the stem bark, root and leaves contain tannins, flavonoids, alkaloids, saponins, phenols etc. (Burkhill, 1995; Okoli *et al*., 2007) conferring the plants ability to function as an anti-bacterial, antioxidants, anti-inflammatory, antiviral, antifungal, hepatoprotective, antispasmodic, anti-allergic, hypolipidemic, neuroprotective, analgesics, immune-modulator, cytotoxic, miracicidal and cercaricidal activities (Carson *et al*., 1998; Swamy *et al*., 2007; Oguntoyinbo *et al*., 2007; Kumar *et al*., 2007; Olorunmaiye *et al*., 2019; Alagbe *et al*., 2019).

In view of the abundant potentials in *Prosopis aficana* and to improve the health status of animals using medicinal plant as alternatives to antibiotics, this study was carried out to examine the proximate, phytochemical and vitamin compositions of *Prosopis aficana* stem bark.

MATERIALS AND METHODS

Experimental site

The experiment was carried out at Sumitra Research Institute, Gujarat, India, between the months of September to December, 2020.

Collection and processing of plant materials

Fresh stem barks from different plants of *Prosopis aficana* were collected within the research farm of Sumitra, Gujarat, India. The stem bark were identified and authenticated by a certified crop taxonomist (Dr. Sjar Sharma), chopped and washed thoroughly with distilled water to remove debris, kept in a plastic sieve for 10 minutes to allow the remaining water drain and shade dried for 13 day to preserve the bioactive chemicals and other nutrients in the sample. The dried sample were blended into fine powder using an electric laboratory blender (Panasonic) Model HDG-02A and stored in a clean, well labeled container for further analysis. *Prosopis aficana* powder was abbreviated as PAD.

Proximate analysis of PAD

Crude fibre (CF), crude protein (CP), ether extract (EE), moisture (MC), and total ash contents were determined according to the methods outlined by the Official Methods of the Association of Official Analytical Chemist (AOAC, 2000). Dry matter in the sample was estimated by subtracting moisture content from 100 while carbohydrate was determined using the formula below:

Carbohydrate (%) = 100 – (MC – CF – CP – EE – Ash)

Phytochemical analysis

Flavonoids, alkaloids, saponin, oxalates and steroids were determined using gravimetric and double gravimetric methods outlined by Harbone (1973). Phenol terpenoids and tannins were determined were estimated using methods described by Harbone (1973), Odebiyi and Sofowora (1978), Boham and Kocipai (1974).

Vitamin analysis

Vitamin compositions of PAD were determined according to the methods outlined by (Achi *et al*., 2017).

Statistical analysis

The analyses were done in triplicates and the data obtained were expressed as mean ± standard error of the means (mean ± S.E.M). The data were subjected to one way analysis of variance (ANOVA) and differences between samples were determined Duncan multiple range test (Duncan, 1955). Significant was declared if $P \leq 0.05$.

Table 1: Proximate composition of *Prosopis aficana* powder (PAD)

Parameters	% composition
Moisture (%)	8.35 ± 0.01
Dry matter (%)	91.62 ± 2.71
Crude protein (%)	4.87 ± 0.00
Crude fibre (%)	45.60 ± 3.51
Ether extract (%)	0.81 ± 0.00
Ash (%)	11.52 ± 0.23
Carbohydrate (%)	28.85 ± 1.22

Values expressed as mean ± SEM (n=3)

Means in the same row with different superscripts differ significantly (*P*<0.05)

Table 2: Phytochemical analysis of *Prosopis aficana* powder (PAD)

Parameters	Composition (%)
Hydrolysable tannins	3.33 ± 0.01
Condensed tannins	0.17 ± 0.00
Alkaloids	5.45 ± 0.02^{a}
Flavonoids	9.83 ± 0.05^{a}
Terpenoids	2.10 ± 0.00
Saponins	1.82 ± 0.00
Phenols	4.02 ± 0.02^{ab}
Phytic acid	0.78 ± 0.01
Oxalates	0.85 ± 0.00

Values expressed as mean ± SEM (n=3)

Means in the same row with different superscripts differ significantly (*P*<0.05)

Table 3: Vitamin composition of *Prosopis aficana* powder (PAD)

Parameters	Composition (mg/100g)
β-carotene	1.51 ± 0.001[a]
Vitamin B1 (Thiamin)	0.33 ± 0.000
Vitamin B2 (Riboflavin)	0.94 ± 0.002[a]
Vitamin B3 (Niacin)	0.42 ± 0.000[a]
Vitamin B6 (Pyridoxine)	0.20 ± 0.001
Vitamin B9 (Folate)	0.18 ± 0.000
Vitamin B12 (Cobalamin)	0.88 ± 0.001
Vitamin C	4.22 ± 0.002[ab]
Vitamin D	0.12 ± 0.000
Vitamin K	0.21 ± 0.002

Values expressed as mean ± SEM (n=3)

Means in the same row with different superscripts differ significantly ($P<0.05$)

RESULTS AND DISCUSSION

Table 1 revealed the proximate composition of *Prosopis aficana* powder (PAD). The proximate concentration reveals the presence of moisture (8.35 %), dry matter (91.62 %), crude protein (4.87 %), crude fibre (45.60 %), ether extract (0.81%), ash (11.52 %) and carbohydrate (28.85%). The moisture content in PAD obtained in this study is higher than the values reported for *Sida acuta* leaf (8.12 %) by Shittu and Alagbe (2020), *Piliostigma thonningii* stem bark (7.11 %), *Daniellia oliveri* stem bark (7.33 %), *Pentadiplandra brazzeana* stem bark (8.15 %) by Alagbe (2020). Moisture content in a sample is used to determine its shelf life, thus sample with low moisture tend to last longer when stored compared to those with high moisture content, this result agrees with the findings of Onuegbu and Iwu (2020). Crude protein in PAD is lower compared to the values reported for Capsicum frutescens (9.4 %), Fagara xanthoxyloides (6.4 %), Hua gaonii stem bark (10.2 %), Monodora myristica (13.6 %), Scorodophleus zenkeri stem bark (14.0 %), Aframomum daniellii (8.5 %), Xylopia aethiopica (7.9 %), Dichrostachys glomerata (8.6 %) by Armand et al. (2012). This result is an indication that PAD may not be able to supply adequate amount of dietary protein to animals, thus it cannot be used as a protein supplement (NRC, 1994; Alagbe *et al*., 2019; Oluwafemi *et al.*, 2020). According to Ojewuyi *et al.* (2014) protein is capable supporting growth, transport of molecules such as oxygen and strengthening the immune system of animals. The high fibre content in *Prosopis aficana* powder is in agreement with the findings of Olanipekun et al. (2016) who reported that *Morinda lucida* stem bark contained 53.49 %. High dietary fibre is advantageous because it reduces the risk of serum cholesterol level, coronary disease and promotes digestion in animals (Fasola *et al*., 2011). The ash content values obtained is lower than those reported in *Boerhavia erecta* stem (16.52 %), Boerhavia root (16.63 %) by Chinelo and Ujunwa (2017). Ash content is an index used to evaluate mineral availability in a sample, the result suggests that *Prosopis aficana* powder is abundant in minerals, this is in agreement with the reports of Ajiboye (2013); Umeaku *et al*. (2018); Omokore and Alagbe (2019). The ether extract reported is lower than values obtained in *Sida acuta* (2.71 %) by Enin *et al*. (2014). Dietary ether extract (fat) is necessary to provide energy especially when carbohydrate is low or deficient in a diet to ensure that animals satisfy their energy requirement (Alagbe, 2019; Oluwafemi *et al*., 2020). Fats also aids the transport of fat soluble vitamins in the body, enhance the structural and biological functioning of the cells in animals (Onuegbu and Iwu, 2020; Pamela *et al*., 2005).

Phytochemical analysis of *Prosopis aficana* powder is presented in Table 2. The sample contained hydrolysable tannins (3.33 %), condensed tannins (0.17 %), alkaloids (5.45 %), flavonoids (9.83 %), terpenoids (2.10 %), saponins (1.82 %), phenols (4.02 %), phytate (0.78 %) and oxalates (0.85 %). In order of abundance flavonoids > alkaloids > phenols > hydrolysable tannins > terpenoids > saponins > oxalates > phytic acid > condensed tannins. The result obtained for flavonoids thus suggests that PAD could perform multiple biological activities as anti-inflammatory, antioxidant, anti-allergic, antiplasmodic and anti-thrombotic (Musa et al., 2020; Olafadehan et al., 2020; Alagbe, 2020; Oluwafemi et al., 2020; Stafford, 1997). Terpenoids are known to posses anti-malaria, anti-inflammatory, antimicrobial, antiviral and inhibition of cholesterol synthesis (Mahato and Sen, 1997; Alagbe, 2020; Omokore and Alagbe, 2019). Saponin exhibits various important pharmacological activities i.e., antibacterial and antifungal activities (Cheeke, 2000; Soetan et al., 2006; Odebiyi, 1978). Tannins are secondary compounds present in plants and comprise polyphenols of great diversity (Hoste *et al.*, 2006). The physical and chemical properties of tannins vary between plants, in different plant parts and between seasons. There are two types of soluble tannins present in a large number of plant species. These are the hydrolysable tannins and condensed tannins. Hydrolysable tannins are characterized by a central carbohydrate core with a number of phenolic carboxylic acids bound by ester linkages and they have been no detection of them in sorghum (Awika and Rooney, 2004). Condensed tannins have no carbohydrate core, but rather they are derived from the condensation of flavonoid precursors without participation of enzymes. Condensed tannins are more widely distributed in higher plant species than the hydrolysable variety and are thought to be more active in precipitating proteins (Dykes *et al.*, 2005). Condensed tannins are naturally occurring compounds found in a number of different plants, including some pasture species (Idso and Idso, 2002). They are made up of groups of polyhydroxyflavan-3 oligomers and polymers linked by carbon-carbon bonds between flavanol subunits (da Silva *et al.,* 2014). Alkaloids have been suggested to perform antimicrobial, analgesic and antiplasmodic effects (Edeoga *et al*., 2005; Kasolo *et al*., 2010). Phytic acid and/or phytates compete with essential dietary minerals such as calcium, zinc, iron and magnesium to make them biologically unavailable for absorption once they exceed their recommended ranges (Alagbe *et al*., 2018; Musa *et al*., 2020). Oxalate is a concern because of its negative effect on mineral availability. High oxalate diet can increase the risk of renal calcium absorption and has been implicated as a source of kidney stones (Chai and Liebman, 2004). The role of phenol is similar to that of Vitamin C; they possess the ability to act as an antioxidant, thus preventing their diseases by scavenging free radicals (Hollman, 2001; Olafadehan *et al*., 2020; Alagbe and Omokore, 2018; Bose *et al*., 1998).

Table 3 revealed the vitamin composition of *Prosopis aficana* powder. The sample contained β-carotene, vitamin B1, vitamin B2, vitamin B3, vitamin B6, vitamin B9, vitamin B12, vitamin C, vitamin D and vitamin K at 1.51 mg/100g, 0.33 mg/100g, 0.94 mg/100g, 0.43 mg/100g, 0.20 mg/100g, 0.18 mg/100g, 0.88 mg/100g, 4.22 mg/100g, 0.12 mg/100g and 0.21 mg/100g respectively. In order of abundance vitamin C > β-carotene > vitamin B2 > vitamin B3 > vitamin B12 > vitamin B1 > vitamin B6 > vitamin K > vitamin B9 and vitamin D respectively. Vitamins are required in trace amounts (micrograms to milligrams per day) in the diet for health, growth, and reproduction. Omission of a single vitamin from the diet of a species that requires it will produce deficiency signs and symptoms. Many of the vitamins function as coenzymes (metabolic catalysts); others have no such role, but perform certain essential functions (Lee, 2000). Classically, vitamins have been divided into two groups based on their solubilities in fat solvents or in water. Thus, fat-soluble vitamins include A, D, E, and K, while vitamins of the B-complex and C are classified water soluble. Fat-soluble vitamins are found in foodstuffs in association with lipids. The fat-soluble vitamins are absorbed along with dietary fats, apparently by mechanisms similar to those involved in fat absorption. Conditions favorable to fat absorption, such as adequate bile flow and good micelle formation, also favor absorption of the fat soluble vitamins (Wardlaw *et al*., 2004). Water-soluble vitamins are not well stored, and excesses are rapidly excreted in the urine (Loosli, 1991). Vitamin A plays a vital role in good sight (vision), support to immune system and inflammatory systems, cell growth and development, antioxidant activity, promoting proper cell communication (Tang, 2010). Vitamin B1 involves in the energy production from carbohydrates and fats, its deficiency in the body could negatively affect the heart as well as the nervous system (Keogh et al., 2012). Vitamin B2 promotes iron metabolism and its deficiency also increase the risk of anemia or blood shortage (Asensi-Fabado and Munne, 2010). Vitamin B3 is essential in production of energy from dietary proteins, carbohydrates and fats (McDowell, 2000). Functionally B6 is very important vitamin as it is involved in red blood cell production, carbohydrate metabolism, liver detoxification, brain and nervous system health (Combs, 2007; Wardlaw et al., 2004). Folates (vitamin B9) support the cardiovascular system, nervous system and also prevents cardio vascular disease in human (Hayden and Tyagi, 2004; Youdim et al., 2000). Vitamin B12 is involved in production of red blood cells and also prevents the increase in level of homocysteine (Lanska, 2010; Crider et al., 2011). Vitamin C helps to boost the immune system by scavenging free radicals; its deficiency induces the disease called scurvy. In case of scurvy, loss of bone strength, lose teeth and bleeding (Feng and Tollin, 2009; Wardlaw et al., 2004). Vitamin D deficiency is associated with many disorders like, osteoporosis, rickets, osteomalacia, loss of balance, diabetes, rheumatoid arthritis, asthma, depression etc. (Jolliffe et al., 2013; Wagner and Greer, 2008). Vitamin K is important for bone health and blood clotting; its deficiency increases the risk of bone fracture (Hirota et al., 2013; Shearer and Newman, 2014).

CONCLUSION

One of the surest ways in preventing the increase in cases of antibiotic resistance diagnosed in both human and animals as well as ailments due to consumption of toxic animal products is the use of medicinal plants. The use of plants is safe, effective and relatively cheap and could also aid to bridge the gap between food safety and efficient livestock production.

CONFLICTS OF INTEREST

The author declares no conflict of interest.

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