The Pharma Innovation Journal 2021; SP-10(12): 1884-1886

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; SP-10(12): 1884-1886

www.thepharmajournal.com
Received: 22-10-2021
Accepted: 24-11-2021

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Proximate analysis of *Azadirachta indica* & *Moringa oleifera* L. leaves as feed additives for ruminants

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Abstract
Aim: To determine the proximate analysis of *Azadirachta indica* (neem) leaves & *Moringa oleifera* leaves powder.
Place of the study: The experiment was carried out in the Forage Research Project laboratory, Department of Agricultural Botany, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist.- Ahmednagar, Maharashtra, India.
Methodology: Association of Official Analytical Chemists (AOAC), official methods of analysis of the was used to determined the proximate composition.
Results: The proximate analysis of *Azadirachta indica* leaves showed the following result; dry matter (DM%) 96.85±0.24, organic matter (OM%) 91.44±0.68, crude protein (CP%) 14.71±0.34, ether extract (EE%) 2.68±0.35, total ash (TA%) 8.56±0.21, nuetral detergent fibre (NDF%) 54.25±1.02 & acid detergent fibre (ADF%) 49.54±0.78. The proximate analysis of *Moringa oleifera* L. leaves depicted following results; dry matter (DM %) 97.54±0.65, organic matter (OM%) 86.84±0.28, crude protein (CP%) 25.14±0.74, ether extract (EE%) 5.14±0.29, total ash (TA%) 13.16±0.32, nuetral detergent fibre (NDF%) 45.24±0.94 & acid detergent fibre (ADF%) 36.1±0.52.
Conclusion: It can be infer from these results of this study, *Azadirachta indica* and *Moringa oleifera* leaves contain a significant number of nutrients that aid in their therapeutic capabilities and serve as good forage for livestock.

Keywords: *Azadirachta indica* (Neem), *Moringa oleifera* L., proximate analysis

Introduction
The evergreen tree *Azadirachta indica* is planted throughout the Indian subcontinent. Since antiquity, every component of the tree has been employed as a traditional medicine for treating various diseases in the home. Ayuveda, Unani, and Hemeophatic medicine have all employed neem extensively. The Sanskrit name for the Neem tree is Arishtha, which means "disease cure" (Kausik *et al.*, 2002). In the middle of the twentieth century, substantial chemical research on neem tree products was carried out. The neem tree is a remarkable plant that has been designated by the United Nations as the tree of the Twenty-First Century (Puri, 1999) [23]. It is known in India as the 'Divine Tree,' the 'Life Giving Tree,' the 'Nature's Drugstore,' the 'Village Pharmacy,' and the 'Panacea for All Diseases' (Shoforowa, 1993) [27].
Moringa oleifera is a tree of the Moringaceae family that originated in the southern Himalayan foothills and is now found in nearly every tropical, subtropical, and semi-arid region of the globe. It can thrive in drought, but with extensive irrigation and fertilisation, harvests can reach over 100 tonnes per hectare. Marango, moringa, reseda, radish tree, ramrod tree, angela, asparagus tree, pearl tree, ben tree, tree of life, drumstick tree, horseradish tree, ben oil tree or benzoil tree, and tree of miracles are some of the common names given to it (Martin *et al.*, 2013). The moringa, or marango, was introduced and naturalised as an ornamental tree in Latin America and Central America around 1920, where it was utilised as a green fence and a wind-blocking tree curtain. This tree is particularly essential in animal feeding because of its strong nutritional properties, which are provided by its protein and vitamin content, and it is used as a supplement for dairy and beef cattle, as well as poultry, fish, and pigs (Garavito, 2008) [9].
Aside from its excellent nutritional content, it generates a lot of green biomass in the field, especially during the dry season, making it a useful source of cattle feed (Sánchez, Sporndly, and Ledin, 2006b; Nouman *et al.*, 2014) [26, 18]. Its potential for animal feed is still unknown, and just a few, scattered investigations of its nutritional value have been conducted in India.

The purpose of this research is to emphasise the importance of evaluating the nutritional value of forages, as well as to refer to studies on the nutritional value of *Azadirachta indica* and *Moringa oleifera* L., with an emphasis on studies conducted mostly in India.

Materials and Methods

Collection of samples

The leaves was collected as part of the plant for proximate analysis. The *Azadirachta indica* (Neem) and *Moringa oleifera* L. leaves powder were purchased from the Shivanand Ayurvedalaya, Dist- Ahmednagar, Maharashtra, India. To avoid confusion, the powder was weighed and collected into clean cellophane bags that were labelled. The sample was stored in a cold, dry place until it was needed.

Proximate Analysis

The samples were analysed for dry matter (DM %), organic matter (OM %), crude protein (CP %), ether extract (EE %), total ash (TA %), neutral detergent fibre (NDF %), and acid detergent fibre (ADF %) using duplicate procedures described by Onwuka, 2005. He also devised a micro Kjeldahl technique for determining nitrogen content, and the nitrogen content was converted to protein by multiplying by a factor of 6.25. The total carbs content was calculated using the 'difference' method. Crude fibre, % crude protein, and carbohydrate content were all proximal values. (Onwuka, 2005) [22].

Statistical Analysis

Statistical analysis was done by using SPSS computer package (Version 22), Analysis of variance (ANOVA) was used to compare the difference between groups considered at significant level of $p<0.05$.

Results and Discussion

The proximate composition i.e. DM, OM, CP, EE, TA, NDF, and ADF of the *Azadirachta indica* (neem) & *Moringa oleifera* leaves powder is presented in Table 1. It reveals that the leaves powder of *Azadirachta indica* contain less moisture. These value indicate that fresh leaves of *Azadirachta indica* can serve as good source of energy because carbohydrate and fat are known to be the main source of energy for organism which include human, livestock, or microorganism. The dry matter content was (96.85±0.24) which is a good attribute for storage (Sadowsky, 2008) [24]. The organic matter (91.44±0.68) pecantage were calculated by subtracting the total ash from 100 and expressed as per cent on DM basis. The crude protein (14.71±0.34) content of *Azadirachta indica* in this study is in optimum range as recommended by the Food and Agriculture Organization (FAO, 2003) which is in the range of 12-15%. This suggests the need to supplement a diet base on *Azadirachta indica* with a complementary protein source to make it more nutritious. The ether extract per cent of neem leaves powder was 2.68±0.35 was within the range (Chaudhary *et al.,* 1999) [6]. The total ash content indicates the degree of the inorganic matter content of the samples. The percentage ash content is (8.56±0.21), this can be attributed to the mineral composition of the leaves. When ash content is abnormally high, there is a very good chance the forage is contaminated with soil which is not desirable. The normal content of legume grass forage is near 9.0%. Those with more than 10-18% ash are likely contaminated with increasing amount of soil, excess ash content can have negative effect on lactation for example in cattle, hence the amount of non- fermentable inorganic matter in some dairy cattle diets get high (Afolabi, 1995; Aganga, 1991) [1, 2] on this basis *Azadirachta indica* can be considered suitable for animal feeds. The percentage NDF & ADF was (54.25±0.1.02 & 49.54±0.78) obtained for leaves powder. These indicate that *Azadirachta indica* leaves contained fibre which can aid in paristalysis.

Proximate analysis of *Moringa oleifera* L. leaves was presented in Table 1. The values of per cent DM, OM, CP, EE, Total ash, NDF and ADF for *Moringa oleifera* Powder was 92.54±0.65, 86.84±0.28, 25.14±0.74, 5.14±0.29, 13.16±0.32, 45.24±0.94 and 36.1±0.52 per cent respectively. Results are more related to Berhane (2000) [4]. *Moringa oleifera* L. is a forage plant whose leaves and stems, acquired by continuous cuttings, have been employed as meal or pellets in animal feeding with a dry matter content of 88 to 92% (Valdivié *et al.,* 2016) [29]. This feed can be handled simply in feed mills, efficiently, and profitably, comparable to how lucerne forage meal and other forage plants with more than 14-16% crude protein are handled globally (CP). Planting densities, establishment period length, cutting frequency, cutting height, drying method, plant genotype, and other environmental and human variations all influence the chemical composition of moringa forage meal (Sánchez *et al.,* 2006; Joshi and Mehta, 2010) [25, 26, 10]. *Moringa oleifera* L. leaf meal contains more crude protein than *M. oleifera* L. forage meal (leaves plus stems) because the first one does not have the stem (Makkar and Becker, 1997; Falowo *et al.,* 2018) [14, 7]. In this sense, Olugbemi *et al.,* (2010) [21] and Moyo *et al.,* (2011) [17] found that crude protein value varies between 28 and 30% when worked with *Moringa oleifera* L. leaf meal without stems.

However, *Moringa oleifera* L. forage meal (leaves + stems) is considered a great source of protein when compared to other grass forages (NRC, 2007; Lemenager *et al.,* 2016) [19, 12] and it has the same the level of the best-recognized protein forages such as the lucerne forage meal (16–22% CP) (NRC, 2012; Sun *et al.,* 2018) [20, 28], hence this alternative feed could be used daily as a partial substitute of corn and soy cake and as a total substitute for lucerne forage meal in the diets of poultry, pigs, rabbits and other non-ruminant species. On the other hand, moringa forage meal has low ether extract (5.14±0.29) content.

Moringa forage meal has an excellent concentration of ashes, according to authors such as Makkar and Becker (1996), 1997; Al-Masri (2003); Sánchez *et al.,* (2006a & 2006b) [13, 14, 3, 25, 26], despite significant chemical variability. In this regard, the calcium content ranges from 0.99 to 3.00 percent, which is ideal for laying hens. However, when this meal is fed in excessive concentrations, it might create mineral imbalances in developing animals or meat producers (especially with phosphorus) (Leeson and Summers, 2009) [11].

Table 1: Proximate composition of *Azadirachta indica* and *Moringa oleifera* leaves powder (%DM basis)

Attributes	Neem Leaves Powder	*Moringa oleifera* Powder
DM	96.85±0.24	92.54±0.65
OM	91.44±0.68	86.84±0.28
CP	14.71±0.34	25.14±0.74
EE	2.68±0.35	5.14±0.29
TA	8.56±0.21	13.16±0.32
NDF	54.25±0.1.02	45.24±0.94
ADF	49.54±0.78	36.1±0.52

Values are means of duplicate results ± SEM

Conclusion

This study reveals that neem leaves contain a significant number of nutrients that could serve as a good source of feed additives in the diet of livestock. The forage meal from *Moringa oleifera* L. has a great source of crude protein, ether extract, total ash and their amino acid concentration is similar to that of the lucerne forage meal, which also has a high content of fibrous compounds, hence it could be included in the diet of ruminants.

Acknowledgement

The authors are thankful to the Dean, Senior scientist and Research guide, Department of Animal Husbandry and Dairy Science, Mahatma Phule Krishi Vidyapeeth, Rahuri- 413722 Dist. Ahmednagar, Maharashtra, India for providing the necessary facilities to conduct the study.

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