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WILD SUNFLOWER *TITHONIA DIVERSIFOLIA* FOR SUSTAINABLE SMALL RUMINANT PRODUCTION IN NIGERIA

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ABSTRACT

Livestock producers mostly desires cheaper feed ingredients that are readily available for the better parts of tropical season and have no competition with man's dietary demands. Wild sunflower, a weed found growing uncultivated on abandoned/waste lands may be employed as livestock feeding resource, hence the need to embark on this study. According to the literature, it was observed that sunflower contains relatively high nutrient concentration which makes it a potential source and supplement of satisfactory quality protein for livestock feed formulation. Percentages vary from 17.20-20.07, 11.00-19.00, 4.00-38.00, 3.36-16.70 and 26.00-50.05 for CP, CF, EE, Ash and NFE respectively. It was also crystal clear that wild sunflower may be included in livestock feeding up to 10% without having any deleterious effect on nutrient digestibility, carcass and blood parameters. When processed, higher inclusion level may be employed up to 30%. Though, it contains anti-nutritional factors, yet the anti-nutritional factors present in Sunflower meals (SFMs) have their peculiarities in regulating rumen microbes by suppressing gram positive bacteria and enhancing the population of gram negatives in the rumen of small ruminants.

KEYWORDS

Wild sunflower, Tithonia diversifolia, sustainable, small ruminant production, Nigeria.

Introduction

The major constraint to ruminant livestock production in the tropic which Nigeria falls is the availability of cheap and quality feedstuffs, especially in periods of drought, dry season of off season (Odedire and Oloidi, 2014). The increasingly expensive nature of most feed ingredient has resulted in reduced livestock production activities by the ordinary peasant farmers who constituted majority of the livestock holder and this has impacted negatively on the available animal protein for human consumption.

Feed alone according to Agbede and Atero (2003) account for 60-80% of the total cost of any livestock. Although, grasses abound in the tropics, season changes in their palatability and nutritive values have been a major challenge in ruminant production (Aloka, 1998).Nutrition from natural pastures is usually not efficient to sustain satisfactory animal production health in Nigeria even under optimal livestock management and stocking rate because they are of low quality. These result in low digestibility and utilization by ruminants, their productivity remains at low ebb. One of the ways to mitigate low animal productions to harness alternative feedstuffs which are accessible to livestock producers is to reduce cost of production. The wild sunflower is one of the new foliages, which is considered by many to be available green manure. Its acceptability ny ruminant and non-ruminant livestock, its relative abundance and the low cost of processing the foliage makes the plant a potential non-conventional animal feed source (Ahaotu andIfut, 2018).

It grows as annual, biennial or perennial plant depending on the habitat. It has been fed to sheep, goat and cattle (Osuga*et al*., 2012) and pig (Oluyemi*et al*., 2006). Therefore, its acceptability by ruminant and non-ruminant livestock and its relative abundance makes it a potential non-conventional animal feed source. The nutritionalcomposition of sunflower seeds and oil has dictated their functionalproperties, also effective in preventing or controlling human diseasessuch as diabetes, cancers, hypertension, hypercholesterolemia,and coronary heart disease (Katsarou*et al*., 2015).

Characteristics of wild sunflower

Wild sun flower is a weed of cultivated cops, wasteland and road sides. It could be cultivated by resource poor farmers who could manipulate planting density to achieve maximum yield (Akinola*et al*, 1999). The plant is an early colonizer at the start of rains and is capable of growing late into the dry season when most forages are no longer available due to drought (Odedire and Oloidi, 2011). This plant has some attribute to quality as a cheaper substitute to conventional resources. It is abundant in nature, it has limited processing demand and it is not in competitive demand for human consumption (Odunsi and Farinu, 1997). It is a fast growing plant that tolerates heat and drought and can rapidly form large herbaceous shrub (CABI 2014). It is adaptable to most soils. It is found in disturbed areas, abandoned and waste lands along roadsides and water ways and on cultivated farmlands (Fasuyi*et al*., 2013). The major limitation to the use of wild sunflower as feed resource is the presence of some anti-nutrient compounds, notably phytin, tannins with some traces of alkaloids, saponin, oxalates and flavonoids (Fasuyi*et al*., 2010).

Nutritional value of wild sunflower

The nutritional components of sunflowers are numerous. Examples are sunflower meal, cake, etc. The sunflower meal or cakerepresenting a unique by-product obtained from the extracted sunflower processed seeds accounts for 36% mass composition, proteincontent ranging between 45% and 50% (Malik &Saini, 2018; Malik, Sharma, &Saini, 2017).Chemical analysis of substrates like wild

sunflower shows that it has high nutrient content which makes it a potential feed resource. Different parts of sunflower can be used as seen in table 1.

Table 1: Chemical analysis of sunflower

	Crude Protein	Crude Fibre	Ether Extract	Ash	NFE	Author
Planted Sunflower leaf	17.20	12.50	6.00	14.02	50.05	Okedu*et al*. (2019)
Wild sunflower	21.14	18.90	4.00	14.14	41.82	Odedire*et al*. (2014)
Ensiled wild sunflower	20.00	19.00	4.00	16.70	26.00	Fasuyi*&Okeke* (2014)
Air-dried sunflower leaf	18.90	11.00	5.50	13.20	51.40	Olayemi*et al*. (2006)
Raw Sunflower seed	18.70	12.92	23.98	3.36	37.68	Akande, (2011)
Processed Sunflower seed	20.07	11.81	24.86	4.98	36.71	Akande, (2011)
Full fat Sunflower	18.00	14.30	38.00	ND	ND	Salari*et al*. (2009)

The common sunflower seed, grown and consumed worldwide, supplies a variety of nutritious components including protein, unsaturated fats, fibre, vitamins (especially E), selenium, copper, zinc, folate, iron and more. The seed according to Premnat *et al*. (2016) also contains 35-42 percent oil and is naturally rich in linoleic acid (55-70%) and consequently poor in oleic acid (20-25%). Sunflower seed and sprout contain high concentrations of niacin and vitamins A, B and C. they are also rich in minerals, specifically calcium, iron, magnesium, phosphorus, potassium, selenium and zinc (Blicharska *et al*. 2014) as well as cholesterol lowering phytosterols. Notably, sprouts offer magnesium and zinc in much higher quantities than the seed. Luka *et al*. (2013) report that sunflower seed extract revealed hypoglycaemic potential, possibly due to secondary metabolites e.g. alkaloids, tannin, saponins, cardiac glycosides, terpenes, steroids and phenols.

Processing methods of wild sunflower

Although *Tithonia diversifolia* has great potential and supplement of satisfactory quality protein in food systems and livestock feed formulation, it may be necessary to employ specific processing methods to eliminate or at least reduce the anti-nutritional factors contained in its biomass which may inhibit the utilization of protein and other nutrient contained in it.In spite the presence of anti-nutritional factors which are always in trace quantities, they have been established to play significant roles in the nutritional quality of foods. However, many food processing techniques have been highlighted as possible means of reducing or eliminating the anti-nutrient levels in plant food source to innocuous levels that can be tolerated by animals particularly in monogastric (Fasuyi&Aletor, 2005). In order to achieve maximum nutritional potential of feedstuffs, processing becomes imperative to detoxify the unwanted endogenous compounds that have the ability to lower nutritive value and could result in mortality in ruminants. Some of these unwanted endogenous compounds are heat-labile (D'Mello, 2000), hence, heat treatments such as boiling and toasting can be used to reduce the effect of the anti-nutritional factors present in browse plants (Ahamefule, 2002). Moisture content could also be modified for processing purposes so as to have safer storage, increase palatability and nutrient availability and this may be done by physical, chemical, thermal, bacterial methods or other alterations of feed stuff before it is fed to ruminants (Campling, 1970; Church, 1971).

Ensiling of wild sunflower can also be carried out to reduce the effects of anti-nutrients. Ensiling as a processing technique, helps to breakdown the fibre content of the crop material, reduce anti-

nutritional factor and increase digestibility as well as dry matter content. Ensiling involves the breaking down of carbohydrates into lactic acid and protein into amino acid, amines andammonia (Pham *et al*. 2006). It increases digestibility of crude protein by breaking down linkages between protein and fibre in the ensiled material. It also increases dry matter and lactic contents. Urea treatment of silage blends of sunflower was reported by Adeosun and Jinadu (2021) to improve silage properties and qualities such as fermented pH and crude protein content of the silage.

Potentials of wild sunflower

In order to obtain good quality seeds, sunflowers should be harvested after reaching physiological maturity with a moisture content of about 10–13% (National Sunflower Association of Canada, 2020). However, younger plants can also constitute valuable agricultural material. Green sunflower plants are used as forage and a silage source by livestock producers because of their nutritional quality, that is, high protein and fat contents (Demirel *et al* 2008; Peiretti *et al*., 2010; Konca *et al*., 2016). Interestingly, young sunflower shoots and florets have long been used in traditional medicine to prepare teas and tinctures, which generally have anti-inflammatory effects (Duke *et al*., 2002).

The antioxidant potential of sunflower seed kernels and hulls, as well as of the seed oil pressing by-product (cakes), has been recognized (De Leonardis*et al*., 2005; Giada and Mancini-Filho, 2009; Zoumpoulakis *et al*., 2017). This potential has been found to be high compared to that reported for other common oilseeds and nuts (Sarkis *et al*., 2014). Phenolic compounds are mainly responsible for the antioxidant potential of sunflower seeds (Karamać *et al*. 2012; Amakura *et al*., 2013). Among these compounds, chlorogenic acid, other caffeoylquinic acid isomers and their derivatives and caffeic acid and its derivatives, together with *p*-coumaroyl and feruloylquinates, and more rarely, flavonoids, have been identified (Karamać *et al*. 2012; Amakura *et al*., 2013; Weisz *et al*., 2009; Pedrosa *et al*., 2000). Presence of saponin in sunflower gives an associated bitterness, not withstanding, its effect on feed intake, the feed stuff containing saponin have been reported to be capable of reducing methane production (Babayemi *et al*., 2004) which makes any feed that contain it a good option in the current phenomenon of climate change.

Table 2: Comparing *Tithiniadiversifolia* with *Panicum maximum* and *Veroiniaamygdalina*

	Tithoniadiversifolia	*Panicummaximun*	*Vernoniaamygdalina*
Dry matter	87.79	86.79	87.96
Crude protein	18.26	11.28	17.18
Ether extract	5.11	3.26	4.28
Ash	11.38	9.88	12.24
Nitrogen Detergent fibre	57.15	65.58	59.21
ADF	31.47	39.79	35.44
ADL	9.21	11.28	10.35
NDF	37.17	30.98	37.47

Source: Ajayi*et al*. (2017)

From the table 2, the chemical composition of *Tithoniadiversifolia* compare favourably with *Panicum maximum* and *Vernoniaamygdalina*, having highest crude protein 18.26g/100g DM and ether extract 5.11g/100g DM, whereas bitter leaf (*Vernoniaamygdalina*) was high in the ash content (12.24g/100g DM) and fibre fractions (NDF, ADF and ADL) compared to the sunflower (Ajayi et al. 2017).

Biological Activities of sunflower

The sunflower seed is a remarkable source of nutrients, minerals, antioxidants, and vitamins possessing anti-oxidant, antimicrobial, antidiabetic, anti-hyperthensive, anti-inflammatory and wound healing capacities (Table 3).

Table 3: Biological activities of sunflower seed and sprout

Biological activities	Biological Compounds
Antioxidant effect	Tocopherols, L-ascorbic acid, antioxidant enzymes, catalase, glutathione, dehydrogenase, gualacol peroxidase, glutathione reductase, carotenoids
Antimicrobial activity	tannin, saponin, glycosides, alkaloids, phenolic compounds
Antidiabetic effects	chlorogenic acid, glycosides, phytosteroids, caffeic acid, quinic acid
Antihyperthensive effect	115 globulin peptides
Anti-inflamation activity	α-tocopherol, triterpene, glycosides, helianthosides
Wounds healing	linoleic acid, arachidonic acid

Source: Guo*et al*. (2017)

The use of sunflower in the treatment or reduction in the risk factorof asthma and diabetes has revealed their health benefits. The antiasthmatic and antidiabetic efficacy of sunflower extracts hasbeen reported (Gad & El-Ahmady, 2018). The oral administration of ethanolic extracts of sunflower seeds extract in rats with antihyperglycemic effect has been reported (Saini& Sharma, 2013). Also, the in vivo antiasthmatic assay of aqueous extract from sunflower on ovalbumin-induced mice and the assessment of their lungs byhematoxylin and eosin staining had revealed the extract potency in reducing asthma effect on the mice (Kim *et al*., 2020). Similarly, the consumption of sunflower seed and oil would probably reduce major risk factors of asthma or diabetes in humans. The antimicrobial activity of methanolic sunflower seeds extracts against some pathogenic Gram-positive and Gram-negative bacteria, which include *Staphylococcus aureus, S. epidermis, Escherichia coli, Proteus vulgaris,*and *Pseudomonas aeruginosa* that might result in food-borne illness has been documented (Menzel*et al*., 2019).

Utilization and inclusion of wild sunflower in livestock production

In this respect, Taiwo *et al*. (2005) showed that sunflower seed has nutritive potentials as a feed stuff for livestock. The percent amino acid content was high and comparable to oil seeds such as soyabean, cotton seed and groundnut seed meal. A preliminary feeding trial conducted by Taiwo *et al*. (2005) using sunflower seed meal did not have adverse effect on the performance, nutrient digestibility and serum chemistry of rabbits. Some studies indicated an inclusion level of 15% SFM in broiler diets without any negative effects on broiler performance and/or other measured parameters (Rama Rao*et al*., 2006; Nassiri Moghaddam *et al*., 2012; Alagawany*et al*., 2018), where as some studies reported that it can be used at higher levels with no adverse effects on utilization and growth performance of broiler chickens (Alagawany*et al*., 2015; Senkoylu, and Dale 2006; Tavernari*et al*., 2008), especially with the addition of enzymes (Bilal *et al*., 2017).

Inclusion of sunflower in feed up to 10% help to reduce nitrogen loss through urine as reported by Odedire and Oloidi (2014) which according to them may be attributed to anti nutritive component of

wild sunflower (Odedire&Oloidi, 2011). A 10% inclusion of sunflower in fattening broiler programme was found to save up to 8% feed cost (Togun *et al*., 2006) which would enhance profitability in broiler fattening programme. Wild sunflower (*Tithoniadiversifolia*) seed supplementation was observed to be highly effective in reducing both protozoa numbers and ammonia nitrogen concentration in rumen fluid of sheep fed silage plus concentrate diet (Ivan *et al*., 2003; Yousuf*et al*. 2014). Meanwhile, a 30 percent sunflower leaf meal based diet was found (Ekeocha *et al*., 2010) acceptable to pre-weaned lambs as it supported dry matter intake, optimum weight gain, weaning weight and feed conversion ratio. It is also a potential source of protein for human consumption due to its high nutritive value and lack of anti-nutritional factors (Smith 1968; Sosulki, 1979). As a fodder, it is rich in protein, valuable for ruminants and rabbit, but less for poultry and pigs, probably due to the presence of fibre and anti-nutritional factors. Contrarily, wild sunflower is commonly used as fodder for ruminants and has also been tested in pigs and poultry with mixed results (Fasuyi et al., 2012).

Significance of anti-nutritional factors in wild sunflower on rumen microbes

Phytochemicals including tannin, saponin, flavonoids, and alkaloids have antimicrobial properties and when in feed can selectively inhibit more of the gram positives bacteria than the gram negatives. Faniyi (2016) reported that herbs suppressed gram positive bacteria and enhanced the population of gram negatives in sheep in vitro. Broudiscou *et al*. (2002) also in their study revealed that some plant species stimulated microorganisms while concomitantly decreasing methane production. Saponin inhibits protozoa and also reduces hydrogen availability for methanogenesis (Guo*et al*., 2008). The gram positive bacteria are the ammonia, hydrogen, formate, lactate and butyrate producers while the gram negatives are the propionic acid and succinate producers (Nagaraja*et al*., 1997). The efficiency of the rumen would therefore be dependent on the type of microbes dominating the rumen at a particular time. This however, would be influenced by the effect of phytochemicals on the different microbial population.

Conclusion

The desire for alternative sources of feed has received increased attention for a while now. Wild sunflower species have the potential to contribute in this regard. Phytochemical and proximate evaluations of sunflower qualifies the plant of high nutritive value to support good growth of 10% inclusion for poultry, 20% for rabbit and pigs and 30% for small ruminants (when the plant is processed compared to feeding raw) without any adverse effect on any of the parameters.

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