ECONOMIC IMPORTANCE OF KENAF SEED AS ALTERNATIVE FEEDRESOURCE IN MICRO LIVESTOCK PRODUCTION:A REVIEW

ABSTRACT

Feed supply has remained a major constraint in animal production due to an ever-increasing cost of conventional feedstuff occasioned by the competition between man and animals for cereal grains. There is need to harness the potential of the numerous agro-industrial by-products and the so-called wastes as part of replacing them for expensive feedstuffs. This necessitated for the utilization of kenaf grains and leaf in the diet of micro–livestock. The cost of conventional feedstuffs coupled with high demand for grains for human consumption has stimulated interest in the use of non-conventional,readily available and cheaper source of feedstuffs. Use of kenaf by-product in other livestock with an impressive result has been recorded without any deleterious effect on the experimental animals. Kenaf is an annual or biennial herbaceous short-lived plant belongs to family, malvaceae and is usually considered as a fiber crop, primarily used for rope, twine, coarse cloth and paper. Hence,kenaf grains and leaf could be used as alternative feed resource for micro-livestock.

Keywords: Kenaf, alternative feedstuff, non- convectional, under- utilized

INTRODUCTION

Animal production in tropical countries relied mainly on the importation of grain protein rather than on the exploitation of the available feedstuff (Swingles *et.al.*, 2001). Cereal generally make up between 55% to 85% of the most of the compounded feed, where protein is normally supplied from oil seed cake and fish protein products. Forage may contribute 40% to 50% of the diet and vital energy source. Because of its high nutrient content, kenaf has been evaluated as animal feed. In poultry, kenaf meal has been satisfactorily incorporated into both broiler and layer diets as a substitute for peanut meal (Rajashelker*et al.,* 1993). Kenaf fed to grazing beef cattle as a supplement resulted in adequate weight gain, body condition score and reproductive performance compared to other forage supplements.

Kenaf grain rich in protein, the crude protein contents vary between 25 and 40% (Killinger,. 1999; Omole *et.al.*, 2012). The fibre content is highly digestible and varied between 6 – 13% depending on the cultivars, time of harvesting and season etc (Killinger, 1999; Omole *et.al.*, 2012). The grain is rich in oil, its content is similar to cotton seed oil and that the oil is an excellent source of edible oil for human consumption (Killinger, 1999). The grain is also rich in minerals such as calcium and phosphorus. Kenaf seed meal has been used to replace soybean fraction of the diet of rabbit with an impressive result. The cost of soy bean meal was fifty six naira six years ago; the price was around one hundred and twenty naira presently. The cost of kenaf grain meal is relatively low compared to that of soybean meal. Kenaf meal has been included in the diet of broiler which has resulted in reduction in the cost of feed without any adverse effect.

OBJECTIVE

To review the effect of substituting kenaf grains and leafas alternative feed resources in micro livestock production.

CLASSIFICATION OF KENAF

To date, identification of a particular kenaf variety still remains complex. Traditionally, the varietal identification is based only on morphological and agronomical features, such as the leaf shape, stem color, and maturity. In fact, it is difficult to identify kenaf varieties based entirely on these features, even though the raw material quality and pulp properties of kenaf are essentially associated with the right identifies of varieties (CHENG*et al*.,1997). The circulation of branded raw materials that contain low quality mixture in the market would affect kenaf's efficient utilization in industry. It is therefore important to find an effective method for accurately identifying kenaf varieties to meet our needs. A quality and identity guaranteed supply of kenaf seeds would also be desirable for their potential utilization in kenaf industry. It is therefore important to find an effective method for accurately identifying kenaf varieties to meet our needs. A quality and identity guaranteed supply of kenaf seeds would also be desirable for their potential utilization in kenaf industry. With the development of new technology, the range of DNA polymorphism assays has been expanded to the field of genetic mapping, marker-assisted plant breeding, genome fingerprinting, and study of genetic relationships (Wildeus e*t al*., 1995). The random amplified polymorphic DNA (RAPD) technology provides a powerful tool for the identification of genetic variation of organisms (Williams *et al.,* 1990). This technology is easy to handle and cost effective, it uses only a single RAPD primer but enables the detection of variations at multiple loci. The RAPD assay has been used for studying genetic diversity studies of many crop species, such as soybean, rice, rose and mustard (Lin *et al.*, 1996).

Table 1. Varieties of kenaf, code and origin

Variety name	**Code**	**Collecting year**	**Source**	**Inferential origin**
Khon Kaen 60	Khkaen1	1998	Khon Kaen, Thailand	Thailand via India
Indian Selection	Indians2	1998	Mississippi, USA	India
Everglades 41	Evergla3	1998	Mississippi, USA	Florida, USA via Cuba–India
Everglades 71	Evergla4	1998	Mississippi, USA	Florida, USA via Cuba–India
Tainung 2	Tainung5	1998	Mississippi, USA	Taiwan via India
Aokawa 3a	Aokawa6	1998	China	Vietnam
Aokawa 3b	Aokawa7	1997	China	Hunan, China
Maruba 204	Maruba8	1998	China	Hunan, China
Zhehong 8310a	Zhhong9	1996	China	Zhejiang, China

Zhehong 8310b	Zhhong10	1997	China	Zhejiang, China
Zhehong 8310c	Zhhong11	1998	China	Guangdong, China
SekkouChuziku	Sekkou12	1997	China	Vietnam
Zhehong 832	Zhhong13	1999	China	Zhejiang, China
Yufeng 1	Yufeng14	1999	China	Guangdong, China

Source: Bitzer *et al.* (2000)

Scientists have reported differences among cultivars for leaf biomass percentages and whole plant protein yields (Webber 1993a; Bhardwaj and Webber 1994). Webber (1993a) reported that cultivar ‘Guatemala 51′ had the greatest leaf biomass percentage (32% leaves) among 5 cultivars (webber, 1993a) and ‘Guatemala 45′ had the greatest leaf biomass percentages (30.9% leaves) among 6 cultivars.

PRODUCTION AND NUTRITIVE VALUE OF KENAF

As livestock feed, kenaf is often harvested at the early stage of growth, 8-13 weeks after planting (WAP), compared to being harvested as a fiber crop, 17 to 21 WAP. An early harvested kenaf (17 WAP) produced more percentage of leaf, stalk and whole plant protein than in 14 and 24 (Webber and Bledsoe, 1993), DM yield of kenaf (729g/m) at 14 WAP was higher than that of 12 WAP kenaf (426g/m), however CP content decreased from 19 to 14%. Therefore, optimal harvesting age of kenaf should be at about 12 WAP (Phillip *et al*., 1999). In Malaysia, the appropriate cutting age of kenaf has been suggested to be at 12 weeks old as far as the DM yield, Dm percentage and fibre content is concerned. When harvested at this growth stage, Kenaf plants can be grown and harvested about four times a year with a potential DM content of about 40.6ton/ha/annual (Najid and Ismawaty, 2001).

Kenaf hay harvested after 19 weeks growth has less CP (11% vs 17.5%) and more neutral detergent fibre (NDF) (52vs39.2%), Acid detergent fibre (ADF)(41.2vs 28.4%) and other cell wall components than alfalfa hay(AH). On the contrast, the chemical composition of the early harvested (8 and 12 weeks growth) whole kenaf plants is approximately equivalent to AH (Swingle *et al*., 1978). Similarly, Suriyajantratrong*et al.* (1973) mentioned that the nutrient profile of immature kenaf leaf is similar to that alfalfa. The juvenile leaves on all kenaf seedlings are simple, entire and cordate. As the kenaf plant matures and additional leaves are produced the newer leaves start to differentiate into the leaf shape characteristics of each cultivar.

Kenaf can be ensilage effectively and it has satisfactory digestibility with high percentage of digestive protein (Wing, 1967). Digestibility of dry matter and crude protein of Kenaf seeds ranged from 53% to 58% and 59% to 71% respectively (Swingle *et al*., 1978). Kenaf meal is used as a supplement in rice ration for sheep and it compared favourably with ration containing Alfalfa meal (Suriyajantrtong*et al*., 1973). It has also been determined that chopped kenaf (29% dry matter, 15.5% crude protein and 25% acid detergent) fibre is a suitable source for Spanish goats (Wildews*et al*., 1995). The leaf yield and biomas percentage are important consideration in selecting cultivars to be used for kenaf forage production because the leaves are the primary source of production (Webber. 1993).

Researches evaluating kenaf as potential forage crop has help to determine that the age of plant at harvest can influence plant composition, such as leaf percentage and protein content (Bhardwaj and Webber, 1994). The leaf biomas normally ranges from 11 to 18 tons/ha, oven dry weight depending on the previously listed production factors. Researchers and producers have reported successful efforts to produce large yields in southern Florida, Southern Texas, over 1,013kg/ha (Joyner and Wilson, 1967). Each of these locations has also reported the need to trade off seed yields for harvest efficiency.

CHEMICAL COMPOSITION OF KENAF:

Its leaves are low in calories and rich in protein and essential oils such as (E)-phytol (28.16%), (Z)-phytol (8.02%), n-nonanal (5.70%), benzene acetaldehyde (4.39%), (E)-2-hexenal (3.10%), and 5-methylfurfural (3.00%) when compared to other leafy vegetables. The leaves are also rich in calcium and phosphorus and have appreciable amounts of Vitamin C. The seeds are rich in essential fatty acids and calories. (Kobaisy*et al.,* 2001)

The chemical composition of the whole kenaf at 6 to 12 weeks old ranges between 17.1 to 23.3% CP, 28.6 to 46.7% NDF, 23.6 to 33.0% ADF, 5.0 to 5.8% hemicellulose, 16 to 19.8% cellulose, 7.3 to 9.2% lignin, and 9.6 to 11.1% ash (Paengkoum*et al*., 2001).

The leaf fraction of kenaf contained 25.7 to 33.8% CP, 11.4% crude fibre (CF), 13.3 -15.2% NDF, 10.4 - 10.9% ADF, 2.7 - 4.3% hemicellulose, 7.2 - 7.1% cellulose, 3.2 - 3.8 lignin, 8.7

- 10.6% ash, 3.3% ether extract (EE) and 49.1% Nitrogen free extract (NFE) (Suriyajantratong*et al*., 1973). Calcium and phosphorus contents are also high (Wong and Vijasegaran, 2001). Base on the production yield and chemical composition, kenaf at early stage of maturity has a potential as fodder protein for ruminants. However, Knowles et al., (1991) reported that kenaf hay had high CP (20.7%) and low ADF (40.2%) content. This would make a poor dietary low hay, fairly dry hay and a good steer or horse hay.

Therefore when discussing kenaf yield and plant composition it is necessary to understand the production factors that influence these plant component and their composition. Kenaf seed oil is 20.4% of the total seed weight which is similar to cotton seed. Kenaf edible seed oil contains:

- Palmitic acid: 19.1%
- Oleic acid: 28.0% (omega-9)
- Linoleic acid: 45% (omega-6)
- Stearic acid: 3.0%
- Alpha-linoleic acid: 3% (omega-3)

Source: Wildeus*et al*., 1995

Seed from kenaf may provide an excellent oil resource. Mohammed *et al.,* (1995) determined the quality and quantity of oil, fatty acids, phospholipids, and sterols in seed of nine kenaf genotypes (‘cubano’ ‘Everglade 41’, ‘Everglades 71’, ‘GR2563’, ‘Guatenmala 48’, ‘Indian’, 178-18RS-10, ‘Tainung #1’, and ‘Tainung #2’). Oil content ranged from 21.4% to 26.4% with a mean of 23.7%.

Total phospholipids ranged from 3.9% to 10.3% of the oil, with a mean of 6.0%. Total sterol percentage was similar to that reported for soya bean and cotton seed oil. Mean sterol content was 0.9% and ranged from 0.6% of the total oil for 178-18RS-10 accession to 1.12% for ‘everglades 71’. Palmitic (20.1% of the total fatty acids), Oleic (29.2%) and linoleic (45.9%) were the major fatty acid and palmitoleic (1.6%) linoleic (0.7%) and stearic (3.5%) were the minor component.

Medium (C12-C14) and long (C22-C24) chain fatty acids were less than 1% of the total phosplolipids. Sphingomyelin (4.42% of the total phospholipids), phosphatidyl ethanolamine

(12.8%), phosphatidyl chlorine (21.9%), phosphatidyl serine (2.9%), phosphatidyl inositol(2.7%), lysophosphatidyl chlorine (5.3%), Phosphatidyl inositol (2.7%), Lysophosphatidyl chlorine (5.3%), phosphatidyl glycerol (8-9%), phosphatidic acid (4.9%), and cardiolipin (3.6%) were identified in the nine genotypes. Phosphatidyl chlorine, phosphatidyl ethanolamine, and phosphatidyl glycerol were the dominant phospholipids. Kenaf relatively high oil content and its similarity to cotton seed oil suggest that the seed oil for human consumption (Wong and Vijasegaran, 2001).

In addition to potential advantage of a longer shelf life, the sterol emulsion could be used in reducing hypercholesterolemia. The high oil content of the kenaf seed can also affect the seeds viability, especially when contemplating longer term seed storage. As with other crop seeds containing high oil percentages, seed viability decreases overtime when stored at high relative humidity (RH) and higher temperatures. Research on kenaf seed storage indicate that seed stored at 8% RH remained fully viable for 5.5 years when stored at either -10^0C, 0^0 or 10^0C and fully viable for 5.5 years when stored at -10^0 or 0^0C at 12% RH (Toole et al, 1960).

Table 2. The chemical characteristics of kenaf

Chemical composition	Kenaf core	Hemp core
Water	7-10%	45-52%
Cellulose	51-52%	45-52%
Hemicelluloses	-	15-20%
Lignin	17	20-30%
Ash	2.9-4.2%	4-5%
Major element		
Nitrogen (N)	0.24%	0.14-1%
Phosphorus (p)	0.06%	0.2-0.5% (P205)
Potassium (K)	0.60%	0.96-1.50%
Sodium (Na)	0.23%	0.09%
Calcium (Ca)	0.18%	0.89-1.4% (CaO)
Magnesium (Mg)	0.17%	0.06%-0.02% (MgO)
Sulphur (S)	0.10%	-
Minor element	Ppm	Ppm

Manganese (Mn)	5	-
Copper (Cu)	7	0.6
Zinc (Zn)	14	-
Boron (Bo)	-	21
Flammability	Flammable	Flammable
Higher heat capacity	4.000kcal/kg	4.055kcal/kg
Lower heat capacity	3.675kcal/kg	3.715kcal/kg

Source: Muchow (1981)

Table 3. Amino acid composition of the leaves of *H. cannabinus* and *H. barteri*(g/100g protein)

Amino acids	*H. cannabinus*	*H. barteri*	FAO Ref.
Lysine	3.96	3.02	4.20
Threonine	3.25	2.26	2.80
Cysteine	0.90	0.83	2.00
Valine	3.85	3.25	4.20
Methionine	0.91	0.86	2.20
Isoleucine	2.81	3.03	4.20
Leucine	7.05	5.66	4.20
Tyrosine	3.06	2.86	2.80
Phenylalanine	4.55	3.86	2.80
Histidine	2.41	2.01	
Arginine	5.02	5.11	

Aspartic acid	7.02	6.69
Serine	1.45	1.72
Glutamic acid	11.11	9.52
Proline	2.50	2.06
Glycine	0.72	1.02
Alanine	1.65	2.25

Source: Wildeus*et al*., 1995

ANTINUTRITIONAL FACTORS IN KENAF SEED

Despite the rich nutritional composition of kenaf seed, there are reports of the presence of a number of antinutritional (toxic) factors. However, there has been conflicting results as per the presence / concentration of these factors probably due to varietal differences. The most commonly reported toxic factors in hibiscus seed are the total phenols, tannins and phytic (Aletor, 1991). Aletor 1991, reported low levels of tannin, amylase inhibitors, protease inhibitors, phytic acid and gossypol in kenaf seed.

EFFECT OF PROCESSING ON THE NUTRITIONAL QUALITY OF KENAF SEED

Different processing methods have been reported to reduce the toxic factors in feeds Odetola*et al.*,(2012), observed that processing methods such as soaking, cooking or roasting significantly improve the nutritional and functional properties of plant seed.

There are few reports on the processing of kenaf seed with the view to reducing the toxic factors and improve its feeding value. Odetola*et al*.., (2012) reported a significant reduction of phenolic compound in the soaked, cooked or sprouted kenaf seed compare to the raw, but the phytic acid content was not affected by processing in a similar study. These processing methods however had both beneficial and adverse changes in the profit of certain nutrients. In their study, Odetola*et al.*, (2012) observed that the reduction of phenolic by soaking, cooking or sprouting were accomplished by significant increase in protein, fat and crude fibre contents while the ash and soluble carbohydrate content were reduced.

Fig 1. Kenaf plantation (*Hibiscus cannabinus L.*)

Source: Popoola Y.A. (2014)

CONCLUSIONS

Although kenaf is usually considered a fiber crop, the entire kenaf plant, stalk (core and bark) and leaves, can be used as a livestock feed. Research indicates that it has high protein content (Killinger 1969). Crude protein in kenaf leaves ranged from 14% to 34% (Webber 1993a), stalk crude protein ranged from 2 to 12% (Webber 1993a), and whole-plant crude protein ranged from 6% to 23% (Swingle *et al*., 1978). Kenaf can be ensilaged effectively, and it has satisfactory digestibility with a high percentage of digestible protein. Digestibility of dry matter and crude proteins in kenaf feeds ranged from 53% to 58% and 59% to 71%, respectively (Swingle *et al*., 1978). It has also been determined that chopped kenaf (29% dry matter, 15.5% crude protein, and 25% acid detergent fiber) is a suitable feed source for Spanish (meat-type) goats (Wildeus*et al*., 1995). Popoola, (2017) noted that, there was no any adverse effect on the growth performance of snail fed with kenaf leaf and seed.

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