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KITCHEN WASTE - A PROMISING FEED RESOURCE FOR LIVESTOCK

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ABSTRACT*:* The study was conducted to find out the chemical composition of different vegetable wastes to use them as feed for livestock to enhance their productivity as well as to reduce feed cost. Total 10 different types of vegetable wastes like Banana tree (*Musa paradisiaca*), Bean leaf (*Lablab purpureus*), Bilimbi leaf (*Averrhoa bilimbi*), Cabbage (*Brassica oleracea* var. capitata), cauliflower (*Brassica oleracea* var. botrytis), Pumpkin (*Cucurbita maxima*), Pumpkin leaf (*Cucurbita maxima*), Radish (*Raphanus sativus*), Ridge guard (*Luffa acutangula*) and Spinach (*Spinacea oleracea*) available in different areas of Chittagong, Bangladesh were collected. Samples were chopped and tested immediately for moisture content and remaining samples were sun-dried and processed using standard procedure. Chemical analyses of the samples were carried out in triplicate for Dry matter (DM), Crude protein (CP), Crude fiber (CF), Nitrogen free extract (NFE), Ether extract (EE) and Ash. Metabolizable energy (ME) was calculated mathematically for all samples by using standard formula. Results indicated that, crude protein content in Banana tree was 15.6 g/100g, Bean leaf 28.2 g/100g, Bilimbi leaf 11.9 g/100g, Cabbage 18.9 g/100g, Cauliflower 17.3 g/100g, Pumpkin 12.9 g/100g, Pumpkin leaf 25.0 g/100g, Radish 14.9 g/100g, Ridge guard 23.4 g/100g and Spinach 11.4 g/100g. In addition to crude protein, all samples contained substantial amount of crude fibre, nitrogen free extracts, ether extracts and ash. It could therefore be inferred that, the vegetable wastes could be incorporated in appreciable quantities for substituting the conventional feed resources of animal diet.

Keywords: Ash, Crude Fiber, Crude Protein, Ether Extract, Kitchen Waste, Moisture, Nitrogen Free Extract.

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INTRODUCTION

Bangladesh is an agricultural country. Livestock is one of its important components which provide protein, solve unemployment and earn foreign exchange (Taylor and Roese, 2006; Cole, 1996). Dairy sector is playing an important role in the economy of Bangladesh. It provides a large part of the increasing demands for animal protein like meat and milk. It also helps to earn cash income by exporting leather and leather products and also by creating employment opportunities. Although, dairying is the most ancient occupation established in the rural setting of Bangladesh, its development is unsatisfactory due to several problems (Shamsuddoha et al., 2000). In commercial dairying, feed cost alone accounts 60-70% of total production cost. Therefore, this is a demand of time to explore locally available cheaper alternative feed resources to reduce feed cost.

Most of the developing countries have been battling against the problem of how to adequately feed their livestock because of inadequate production of conventional feed ingredients for livestock feeding. Many of these countries are also well blessed with considerable good fertile, arable land, good sunshine and abundant and well distributed rainfall. The inadequate quantities of concentrated feedstuffs they produce yearly are competed by humans and their livestock. Usually humans have to have their needs satisfied first leaving the remainder for livestock (Babatunde, 1992).

Cattles have been fed various crop residues and unconventional feedstuffs for years. Proper utilization of unconventional feeds by ruminants will not only benefit the animal industry but will increase the economic return of many cash crops (Mustafa, 2002). Vegetable and fruit by-products have a good potential for use of ruminant and non-ruminant rations so that the gap between the demand and supply of feeds and fodders can be shortened. Efforts are focused on determining the seasonal availability and nutritive value of locally available fruit and vegetable by-products with a view to formulate adequate year round feeding system (Kumar et al., 2010). Therefore, present study was undertaken to find out the chemical composition of some neglected fruits and vegetable wastes to bridge the gap between the demand and supply of the conventional feeds for livestock.

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MATERIAL AND METHODS

Study area

There are lots of small and large scale farm in Chittagong metropolitan area where most of the farmer usually feed their livestock with unconventional feed along with conventional based on availability. Therefore, local unconventional feeds available in these areas were selected as the study area.

Collection of sample

Samples were collected by using simple random sampling technique. Total 10 different vegetable waste samples were collectedly randomly. Approximately 2000 grams of each sample was collected. Samples were wrapped up by polythene bag and preserved in the laboratory for chemical analysis.

Preparation of sample

Samples were subjected to grinder to make it homogenous powder after sun drying. Later on, it was mixed properly and exposed to shade to cool down for sampling. Individual samples were identified by marker and subjected to chemical analyses.

Analysis of sample

Chemical analyses of the samples were carried out in triplicate for moisture, dry matter (DM), crude protein (CP), crude fiber (CF), nitrogen free extracts (NFE), ether extracts (EE) and ash in the animal nutrition laboratory and PRTC laboratory in Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh as per AOAC (1994).

Calculation of ME

Metabolizable energy (ME) was calculated separately for all 10 different feed samples. Calculation was performed by mathematical formula as per Lodhi et al. (1976).

Statistical analysis

Data related to chemical composition of unconventional feeds were compiled by using Microsoft Excel 2007. Chi-square (χ^2) test was performed to analyze the data by using SPSS 16.0. Statistical significance was accepted at 5% level ($P<0.05$).

RESULTS AND DISCUSSION

Chemical composition of the vegetable wastes particularly, moisture, dry matter (DM), crude protein (CP), crude fiber (CF), nitrogen free extract (NFE), ether extract (EE) and total ash contents in different samples have been presented in Table 1 . In this study proximate components were determined to make a decision as to whether they could be a suitable alternative for conventional feeds or not.

Table 1 - Chemical composition (g/100g DM) of the vegetable wastes available in Chittagong district, Bangladesh

English name	Scientific name	ME	DM	CP	CF	NFE	EE	Ash
Banana tree	*Musa paradisiaca*	1909.7	4.0	15.6	27.7	40.3	1.3	15.1
Bean leaf	*Lablab purpureus*	2510.4	18.8	28.2	15.7	41.0	3.5	11.6
Bilimbi leaf	*Averrhoa bilimbi*	1980.8	32.2	11.9	32.3	43.3	2.6	9.9
Cabbage	*Brassica oleracea*	2521.1	6.1	18.9	13.8	56.4	0.9	10.0
Cauliflower	*Brassica oleracea*	2316.8	9.7	17.3	21.0	50.5	1.5	9.7
Pumpkin	*Cucurbita maxima*	2889.2	12.6	12.9	9.9	70.8	2.1	4.3
Pumpkin leaf	*Cucurbita maxima*	1802.0	14.0	25.0	20.4	40.1	0.7	13.8
Radish	*Raphanus sativus*	2544.0	6.3	14.9	13.6	61.1	0.9	9.5
Ridge gourd	*Luffa acutangula*	2577.5	18.3	23.4	12.1	53.0	1.2	10.3
Spinach	*Spinacea oleracea*	2469.1	8.7	11.4	13.9	59.4	2.2	13.1
SEM		109.7	2.7	1.8	2.3	3.3	0.3	0.9
Level of sig.		***	***	*	***	*	NS	NS

ME=Metabolizable energy (kcal/kg DM); DM=Dry matter; CP=Crude protein, CF=Crude fibre, NFE=Nitrogen free extract, EE=Ether extract; NS=Non-significant ($P>0.05$); SEM=Standard error of mean; *=Significant at 5% level ($P<0.01$); ***=Significant at 0.1% level ($P<0.001$)

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Banana tree (*Musa paradisiaca*)

The local name of banana tree is Kola tree and scientific name is *Musa paradisiaca*. The banana tree is the largest herbaceous flowering plant in the world. It has been found that the starch-rich bananas have curative properties both scientifically and traditionally. Birds and animals, especially monkeys and elephants love bananas. There are many healing and medicinal properties of banana tree. The high content of iron in bananas increases the production of hemoglobin in the blood. Therefore, bananas are very good for anemia. Basically, all part of the banana tree have medicinal application. Fruits, leaves, peels, roots and stalks from banana plants have been used orally as a medicine for treating diarrhoea and dysentery as well as for healing the intestinal lesions in colitis (Stover and Simmonds, 1987). The banana plant is used in folkloric medicine for treating inflammation, pain and snake-bite by the Sumu (Ulwa) people of south-eastern Nicaragua (Coe and Anderson, 1999; Lim, 2012). In our study, banana tree contained 1909.7 kcal ME/kg DM, 4.0 g/100g dry matter, 15.6 g/100g crude protein, 27.7 g/100g crude fiber, 40.3 g/100g nitrogen free extracts, 1.3 g/100g ether extracts and 15.1 g/100g ash (Table 1). Banana tree is very common and available in all region of Bangladesh. It is one of the leading sources of iron and advisable for anemic animals. Thus, banana tree can be an alternative feed source for livestock.

Bean leaf (*Lablab purpureus*)

Scientific name of banana is *Lablab purpureus*. It is an annual or short-lived perennial dual-purpose legume. It belongs to the family Fabaceae and genus Lablab grown in the tropics. The seed and immature pods can be used for human food (Purseglove, 1968) while the herbage is used as a feed supplement for ruminant grazing during the dry season (Schaaffausen, 1963). Reports are however, limited on its use as a feed resource for monogastric animals. In present study, bean leaf contained 2510.4 kcal ME/kg DM, 28.2 g/100g crude protein, 15.7 g/100g crude fibre, 3.5 g/100g ether extracts, 41 g/100g nitrogen free extracts and 11.6 g/100g ash. In a study *Lablab purpureus* had 76.4 g/100g dry matter in leaf and incase of stem it was 84.1 g/100g for rongai variety (Karachi, 1997). Protein content was 25 g/100g for leaves and 11.88 g/100g for stems. Ajayi et al. (2009) found 41.8 g/100g crude fiber 26.9 g/100g dry matter, 18.1 g/100g crude protein, 28.5 g/100g crude fibre and 2.6 g/100g ether extracts in bean leaf. Aganga and Autlwetse (2000) reported 16.4 g/100g crude protein for whole plant Lablab hay. The DMD for the leaf and stem was 64.4 g/100g and 44.2 g/100g respectively.

Bilimbi leaf (*Averrhoa bilimbi*)

Bilimbi leaf is a member of the Oxalidaceae family. The local name of Bilimbi leaf is Bilambu and scientific name is *Averrhoa bilimbi*. Mature bilimbi leaf is usually 3-6 cm long, alternate, imparipinnate and cluster at branch extremities. There are around 11 to 37 alternate or sub-opposite oblong leaflets. The leaves are quite similar to those of the Otaheite gooseberry. Possibly originated in Moluccas, Indonesia, the species are now cultivated and found throughout the Philippines, Indonesia, Sri Lanka, Bangladesh, Myanmar and Malaysia. It is also common in other Southeast Asian countries. In India, where it is usually found in gardens, the bilimbi has grown wild in the warmest

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regions of the country. This is essentially a tropical tree, less resistant to cold. The leaf of A. bilimbi is used for the treatment of stomachache and parotitis. The fruit is used to treat dyspepsia, colitis and also dental caries. It is also used to treat bleeding haemorrhoids, bleeding gums, mouth ulcers, dental caries and to alleviate internal haemorrhoids. Infusion of the flowers is a remedy for mouth ulcers and oral thrush (Peter, 2007 and Orwa et al., 2009). Leaf decoction also heals inflammation of rectum and as paste of it is applied on affected surface area for mumps, rheumatism and pimples. Leaves, flower and fruit are consumed for stomachache, wounds, stomatitis, whooping cough, bleeding gums, ache and hypertension as well as antitussive and antidiabetic (Peter, 2007). It is also good for scabies (Batugal et al., 2004). In present study, bilimbi leaf contained 1980.8 kcal ME/kg DM, 32.2 g/100g dry matter, 11.9 g/100g crude protein, 32.3 g/100g crude fiber, 43.3 g/100g nitrogen free extracts, ether extracts 2.6 g/100g and 9.9 g/100g ash (Table 1). Bilimbi leaf is favorite to goat. It can also be used for cattle and sheep in our country as unconventional feed.

Cabbage (*Brassica oleracea* var capitata)

Cabbage (*Brassica oleracea* var capitata) is an herbaceous flowering plant with leaves forming a compact head chrematistics. This is an abundant feedstuff both for man and animal and available throughout the whole country. This is low in calorie because of its high water content. Cabbage is a good source of fibre, provitamin A, vitamin C and B9. It is a vital source of calcium. Recently, cabbage was found to contain substances such as indole, isothiocyanates and dithiolthiones which seem to have powerful anti-cancer properties. A wide number of experiments performed over last twenty years, both on animals and people have confirmed the beneficial effect of eating cabbage on a regular basis to help prevention of colon, stomach, lung and oesophagus cancer. Akula et al. (2007) mentioned that, cabbage contained 2.4 kcal ME/gDM, 92.0 g/100g moisture, 1.3 g/100g protein, 0.2 g/100g fat, 5.4 g/100g fibre. In present study, cabbage contained 2521.1 kcal ME/kg DM, 93.9 g/100g moisture, 18.9 g/100g crude protein, 13.8 g/100g crude fibre, 0.9 g/100g ether extract, 56.4 g/100g nitrogen free extracts and 10.0 g/100g ash. Cabbage leaf contains high levels of glucosinolates, which form compounds with antioxidant and anticancer activities during preparation (Mvere and Werff, 2004). According to Gopalan et al. (2004), brassica vegetables are highly regarded for their nutritional value as they provide higher amounts of vitamin C, soluble fibre and many other multiple nutrients with potent anti-cancer properties. It has recently been discovered that 3, 3-Diindolylmethane in Brassica vegetables is a potent modulator of the innate immune response system with potent anti-viral, anti-bacterial and anti-cancer activity. Iron in leaf cabbage is available in an easily digestible form (Mvere and Werff, 2004).

Cauliflower (*Brassica oleracea* var. botrytis)

Cauliflower (*Brassica oleracea* var. botrytis) is a vegetable. Its scientific name is *Brassica oleracea* var. botrytis species. It originated in the northeast Mediterranean and is presently cultivated in most of the countries of the world including Bangladesh. Cauliflower has a small compact head covered with hundreds of flower cluster attached to a short stalk. Cauliflower's nutrients make it a true champion in the fight against cancer. In addition to fibre, this is a good source of protein, thiamin, riboflavin, phosphorus, potassium, vitamin C, vitamin K, vitamin B6, folate, pantothenic acid and manganese. In present study, cauliflower contained 2316.8 kcal ME/kg DM, 91.3 g/100g moisture, 17.3 g/100g crude protein, 21 g/100g crude fibre, 1.5 g/100g ether extract, 50.5 g/100g nitrogen free extracts and 9.7 g/100g ash. Cauliflower contains 2.7 kcal ME/g DM, 97.0 g/100g moisture, 2.7 g/100g protein, 0.2 g/100g fat and 5.2 g/100g crude fibre (Akula et Al., 2007). In another study, cauliflower contained 1.9 g/100g proteins, 91.95 g/100g water, 0.7 g/100g ash and 2 g/100g dietary fiber. According to Gopalan et al. (2004), cauliflower contained 66 kcl energy, 80.0

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g/100g moisture, 6.0 g/100g protein, 1.0 g/100g fat, 3.0 g/100g mineral and 2 g/100g fibre. Therefore, cauliflower and its wastes could be a promising alternative feed resource for livestock.

Pumpkin (*Cucurbita maxima*)

Pumpkins (*Cucurbita maxima*) are gourd squashes of the genus Cucurbita and family Cucurbitaceae. The pumpkins are cultivated worldwide and have high production yields. In fact, most of the species belongs to the Cucurbitaceae family is a nutritious food in Bangladesh. With a high nutritional value, pumpkins are associated with a lot of health benefits. Apart from the flesh, even the seeds of pumpkins boast of a large number of nutrition benefits. The high amount of fiber present in a pumpkin, is good for the bowel health. Pumpkin is very rich in carotenoid which is known for keeping the immune system strong and healthy. Being rich in alpha-carotene, pumpkin is believed to slow down the process of aging and also prevent cataract formation. Pumpkins have been known to reduce the risk of macular degeneration and a serious eye problem like blindness. In present study, pumpkin contained 2889.2 kcal ME/kg DM, 87.4 g/100g moisture, 12.9 g/100g crude protein, 9.9 g/100g crude fibre, 2.1 g/100g ether extract, 70.8 g/100g nitrogen free extracts and 4.3 g/100g ash. In another study, Rahman (2008) found 4.0 g/100g dry matter, 1.0 g/100g crude protein, 0.7 g/100g crude fibre, 0.1 g/100g ether extract in pumpkin which is contradictory to our finding. Jenkins, (2010) found 16.5 g/100g dry matter, 14.45 g/100g crude protein, 38.6 g/100g neutral detergent fiber, 32.5 g/100g acid detergent fiber in pumpkin. So pumpkins are a good source of energy and adequate in protein for beef cattle.

Pumpkin leaf (*Cucurbita maxima*)

Pumpkin leaf is one of the important crops which belong to the family, Cucurbitaceae. The local name of pumpkin leaf is Misty kumra shak and scientific name is *Cucurbita maxima*. Pumpkin leaf is very common in Bangladesh. This is found all over the country. Most parts of the pumpkin are edible, including the fleshy shell, the seeds, the leaves, and even the flowers. It is a traditional vegetable crop, grown mainly for its leaves, fruits, and seeds and consumed either by boiling the leaves and fruits or by roasting or baking the seeds (Facciola, 1990). Pumpkins are grown all around the world for a variety of reasons ranging from agricultural purposes such as animal feed to commercial and ornamental sales. Of the seven continents, only Antarctica is unable to produce pumpkins. The biggest international producers of pumpkins include the United States, Canada, Mexico, India, and China. The traditional American pumpkin is the Connecticut field variety.

Pumpkin leaves, fruits, flowers and seeds are health promoting food. Different parts of the plant have been used as medicine in some developed world. The leaves are haematinic, analgesic, and also used externally for treating burns. Traditionally, the pulp is used to relieve intestinal inflammation or enteritis, dyspepsia and stomach disorders (Sentu and Debjani, 2007). Pumpkin fruit is an excellent source of vitamin A which the body needs for proper growth, healthy eyes and protection from diseases. It is rich in vitamin C, vitamin E, lycopene and dietary fiber (Pratt and Matthews, 2003; Ward, 2007). It has also been featured in various systems of traditional medicine for several ailments such as antihypertensive, antibacterial, intestinal antiparasitia, anti-inflammation and antalgic (Bown, 1995; Burkill, 1985; Chiej, 1984; Chopra et al., 1986; Rahman et al., 2008).

In our analysis, pumpkin leaf contained 1802.0 kcal ME/kg DM, 14.0 g/100g dry matter, 25.0 g/100g crude protein, 20.4 g/100g crude fiber, 40.1 g/100g nitrogen free extracts, 0.7 g/100g ether extracts and 13.8 g/100g ash (Table 1). The result is in agreement with Idris (2011) who found 13.0 g/100g dry matter, 8.72 g/100g crude protein, 20.17 g/100g crude fiber and 17.2 g/100g ash in pumpkin leaf. The potential of a particular feed is determined primarily by its nutrient composition. Leafy vegetables like pumpkin leaves are known to add taste and

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flavour, as well as substantial amounts of protein, fiber, minerals, and vitamins to the diet (Oyenuga and Fetuga, 1975). So, it could undoubtedly be a good ration item for livestocks.

Radish (*Raphanus sativus*)

Radish (*Raphanus sativus*) belongs to Brassicaceae family. It is cheap and available feedstuffs in Bangladesh and found around 6 month in a year. Radishes are known for their anti-bacterial and anti-fungal properties. Radish contains vitamin C, potassium, sodium and trace amount of other minerals. Radishes are low in saturated fatty acids. They are a good source of riboflavin, vitamin B6, calcium, magnesium, copper and manganese. Radish is an excellent source of dietary fiber, folate, vitamin C and potassium. Radish is an important vegetable crop worldwide. In present study, radish contained 2544.0 kcal ME/kg DM, 93.7 g/100g moisture, 14.9 g/100g crude protein, 13.6 g/100g crude fibre, 0.9 g/100g ether extract, 61.1 g/100g nitrogen free extracts and 9.5 g/100g ash which is close to the result of Zhao-liang et al. (2008) who found 29.7 to 88.2 g/100g dry matter, 4.507 to 18.546 g/100g crude fiber, 2.233 to 15.457 g/100g total soluble sugar, 0.1416 to 0.3341 g/100g vitamin C and 0.34 to 1.15 g/100g protein on fresh weight basis.

Ridge gourd (*Luffa acutangula*)

Ridge gourd (*Luffa acutangula*) locally known as Dhundol. The fruits are edible and eaten as vegetable. It is good for health. The seeds are emetic and carthartic. Young fruits are cool, demulcent, producive of loss of appetite and extive of mind bile and phlegmare (Rahman et al., 2008). This is low in saturated fat and cholesterol, high in dietary fiber, vitamin C, riboflavin, zinc, thiamin, iron, magnesium and manganese. It has blood-purifying properties. It helps to purify, restore and nourish liver from alcohol intoxication. It has high beta carotene that is good for eyes. In present study, ridge gourd leaf contained 2577.5 kcal ME/kg DM, 81.7 g/100g moisture, 23.4 g/100g crude protein, 12.1 g/100g crude fibre, 1.2 g/100g ether extract, 53.0 g/100g nitrogen free extracts and 10.3 g/100g ash. Hussain et al. (2010) found 7.31 g/100g dry matter, 13.47 g/100g crude protein, 2.09 g/100g crude fibre, 2.09 g/100g ether extract and 5.55 g/100g ash in ridge gourd leaves which is close to our findings. In another study (Abitogun, 2010) the range of the proximate components in ridge gourd leaf was crude protein (42.17-70.65 g/100g), moisture (5.69-6.42 g/100g), fat content (1.53-33.64 g/100g), ash content (3.87-3.92 g/100g), crude fibre (1.95-2.80 g/100g), carbohydrate (12.68-14.68 g/100g) and the available energy (1507.53-2177.13KJ).

Spinach (*Spinacea oleracea*)

Spinach (*Spinacea oleracea*) belongs to the Amaranthaceae family. This is a wonderful green-leafy vegetable often recognized as one of the functional foods for its nutritional, antioxidants and anti-cancer constituents. Around 100g of spinach contains about 25 g/100g of the daily intake of iron. Spinach is a leafy green vegetable of winter season. Spinach is a prominent source of iron, vitamins A and C, thiamin, potassium and folic acid, carotenoids, lutein and zeaxanthin (Abbas et al., 2010). It contains 3.2 g/100g protein, 0.3 g/100g fat and 4.3 g/100g fibre (Akula et al., 2007). According to Gopalan et al. (2004) spinach contained 2.6 kcal ME/g DM, 92 g/100g moisture, 2.0 g/100g protein, 1.0 g/100g fat, 2.0 g/100g mineral and 1.0 g/100g fibre. In present study, spinach contained 2469.1 kcal ME/kg DM, 91.3 g/100g moisture,

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11.4 g/100g crude protein, 13.9 g/100g crude fibre, 2.2 g/100g ether extract, 59.4 g/100g nitrogen free extracts and 13.1 g/100g ash.

CONCLUSION

The role of unconventional feeds in livestock nutrition continues to increase. The utilization of unconventional feeds will not only benefit the livestock industry but will also increase the economic return for several crops in Bangladesh. To standardize the feeding value of unconventional feeds, a systematic evaluation system based on based direct feeding trial should be adopted in future.

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Competing interests

The authors declare that they have no competing interests.

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