**CHAPTER I**

**INTRODUCTION**

Bangladesh is the country of south Asia, bordering the Bay of Bengal, between Burma and India. Bangladesh has a total area of 143,999 sq. km. The total population is 164 million (BBS, 2010). Of them 47% live below the poverty line and 27% live in extreme poverty. Over 25 million people are classified as the poorest by any standard of development **(BBS, 2005)**

Bangladesh is by mid 2008 classified as a low income country, i.e. with a GDP per capita of US $ 450 in 2006 below the cutting line of US $ 935 **(World Bank, 2008).** Its population is more than 144 million in 2006 places it as the seventh most populous country in the world **(Xist, 2008).** The economy of Bangladesh is agro based. About 21.77% of Gross Domestic products (GDP) come from agriculture sector of which livestock alone share 7.23%. **(BBS, 2005-2006)**. Bangladesh have 24.7 million cattle, 0.86 million buffalo, 1.34 million sheep and goat, 195 million poultry(DLS2006). About 89% of rural households rear poultry and average number of bird per house is approximately 6.8 (The Bangladesh Census of Agriculture, 1996). Poultry industry is an emerging agribusiness started during eighties in Bangladesh. Broiler and layer farming is an important part of commercial poultry enterprise. It provides a large part of increasing demand for animal protein, cash income and creates employment opportunities. Broiler production in Bangladesh is increasing day by day. The higher price and non-availability of feed ingredients are two major limitations to the growth of commercial broiler enterprises. The feed cost alone accounts 60-70% of total production cost and the broiler farming requires quality feed at reasonable cost to make farming profitable (Bulbul and Hossain, 1989). Therefore, it is imperative to explore cheaper locally available feedstuff to reduce feed cost. About 80% feedstuffs used in poultry ration are being imported. As a result, the cost of feed prepared for poultry using those grains stand high. Computing feed with conventional feed ingredients available hardly permits profitable poultry production.

Now attention is, therefore being focused on cheap but suitable alternative feedstuff, especially crop residues and industrial by product, to sustain livestock industry(Al Hassan,1985).The evaluation of unconventional feed resources alongside other strategies would reduce pressure on the demand for conventional feed ingredient and accelerate the attainment of feed security for poultry (Fajimi et al;1993). For this purpose saw dust can be used as unconventional feed resources for livestock. Million of lignocelluloses material(saw dust) which are wasted every year are found around industrial sites such as sugar mills and saw mills can be used as unconventional feed ingredient (Piden and Bender, 1975). Sawdust have been used as diluents for adapting cattle feed (D.A. Dinius and Williams, Dept. of agricultural, Beltsville, Maryland,2005).

Dairy farmer who are critically short of cash and normal forages, straw or Stover might consider feeding of hard wood saw dust or thin savings in limited amounts. Some research done at every experiment stations suggested that total ration dry matter as a partial replacement for forage(Richard S.Adams, pennstate Emeritus, professor of dairy science,8148633917).The inclusion of 5-15% sawdust in maize based diets for cattle was found to maintain better rumen function as evidence by fewer cases of bloat and liver lesions and less ruminal perakaratosis (Zora varadyova, imrich Zelenak ,piter siroka, Slovak republic academy of science).During fiber feeding to bird fiber reduces density of the diets (Savoryand Gentle,1976)and makes more feed in order to acquire enough for metabolic activities (Abdelsamic et, al ,1982). Japanese quails feed on diets diluted with either oak sawdust or cellulose powder consumed more feed than birds feed on the same diets undiluted (low fiber), (Savory and gentle,1976).

Sawdust is a byproduct of tree timber. It has a great value in nutritional basis. Sawdust is abundant and found thought the year in developing country, the utilization of sawdust will reduce the cost of livestock feed. Sawdust will not competitive with human feed. Despites of wide range of advantages, the quality of sawdust available in the Bangladesh is questioned. Therefore, the present study was aimed to-

i.To investigate the chemical composition of sawdust in Rangamati district of Chittagong, Bangladesh .

ii.To assess the nutritional value of this sawdust as animal feed.

**CHAPTER II**

**REVIEW OF LITERATURE**

Sawdust is a byproduct of sawmills and is the cheapest sources of energy and protein for livestock and poultry. Sawdust is one such product that abundantly and cheaply available during the all season.

It is a byproduct of cutting lumber, with a saw. It is composed of fine particles of wood. Sawdust is a huge sawmills waste and produced during cutting of timber with a saw. Although it has been recognized as an excellent sources of energy, protein etc but underutilized by human. Sawdust contains high value of vitamin and mineral. W.B. Anthony, John P. Cunningham, R.R. Harris (1968) have made an experiment about utilization of sawdust in ruminant. Ruminant animals can utilize cellulose materials as food because of a valuable symbiotic relationship with microorganism present in rumen section of their digestive tract. Cellulose pulps and wood waste have been fed as maintenance rations to cattle and horses during times of great national emergencies.

King (1984), Sawdust can be used as rabbit feed. If rabbit feed contain 3-4% fiber , rabbit have been eating edges of wooden hutches. In experimental diets, purified wood cellulose is often given as an attempt to reduce feed cost.

T.A. Omale, O. Conwudike (1981), Treated rabbit diet with sawdust (soft wood and hard wood) 6% solution of NAOH and then again treated with 0.3% solution of NAOH. The rate of gain increase in rabbit those are treated with 6%NAOH containing sawdust feed than 0.3% NAOH containing sawdust feed.

Ferguson (1942); Saurimen et al (1985), The alkaline treatment for sawdust resulted in a marked increase in the digestibility of all constituents except lignin and provided highly digestible product.

Hunter et al (1981), Stated that, the main value of sawdust appears to be as a source of dietary fiber in rabbit diet ration.

Richad, S. Adans, Pemstste Emeritus (1997), The estimated nutrient content of hardwood sawdust or thin savings is on a dry matter basis: crude protein 1.65%, acid detergent fiber 81%, TDN 0.33%, NEL 300 Mcal/lb, calcium 11%, phosphorus 0.02%. The feeding value may be higher than individual by its energy content due to the contribution to the physical needs of the ruminant.

Mokhtar S. Radwan (EL-Fayoum, Egypt), The chemical analysis of sawdust was: crude protein (2.53), Either extract (0.76%) ,NFE (24.53%), crude fiber (60.25%), Ash (1.86%), those for dry matter digestibility coefficient were 72.6%, 62.0%, 71.8% and72.2% and those for organic matter were 73.8%, 63.8%, 72.4% and 72.o % respectively.

(W.B.Anthony, John, P.Cunnigham, R.R .Harris, 1968), Cellulose pulps and wood waste have been feed as maintenance rations to cattle and horses during times of great national emergencies.

QU RAT-UL-AIN, S.AIG AND M.SALEEM, Punjab, Lahore, Pakistan,(54590), A comparative proximate analysis of sawdust and rice husk was performed under department of botany, Lahore. They found the following proximate parameter. In sawdust, moisture (7.8%), ash (2.2%), fat (2.3%). In rice husk contain moisture (7.5%). Ash (17.35%), fat (8.2%).

Robert E.CODY, J.L.MORRILL AND C.M HIBS (1972), About 25% sawdust appeared to be the most desired level for roughage substitution. Higher level occasionally induced impaction of digested. Voluntary regulation of feed intake comparable with Morrison recommendation for rapid growth of calves accomplished with feed containing 35% sawdust.

Dboke and Mooke, olabisi onabanjo university, Nigeria, The two scientist were made a study about chemical analysis of composition of wood waste (sawdust). Sawdust contain DM (997.20), ASH (6.40), CP (8.80), CF(676.10), EE(14.70), total Carbohydrate (294.00). All component were analyzed by g/kg dry matter basis.

Fiber reduces density of diets (Savory and Gentle, 1976), and makes birds to consume more feed in order to acquire enough energy for metabolic activities (Abdelsamie et al;1983;Moran,1997;Fanjiyi and ologhobo; scott et al;1982).

Sawdust has been fed in all concentrate ration as a roughage substitute in ruminant (Marion et all;1959), Anthony and Cunningham (1968), Dinius et all;(1970) and constituentsexcept lignin and provided highlydigestible products (Ferguson, 1942**;** Saarinen ***et al.,* 1958).** However, thechemical treatment of sawdust is costing (Mïllett ***et al,* 1970).** Although treating sawdust with sodium hydroxide, boiling **or** fermenting with poultry manure can increase the nutritive value for sawdust, it needs chemicals, effort and in addition to that needs special experience to run these treatments. It is so easy to rabbit keepers to know the proportion of sawdust that can beincorporated into diets. Hunter ***et al.* (1981)** kanstra, (1973, 1974) Macastoretal, (1970). Chemical treatment which alter the lignin cellulose bonds have increased the digestibility of various wood wastes. (Wilson and Pidgen,1964;Tarkaw and Feist 1968,1969;Feist et al,1970)

The vitro dry matter digestibility has been improved by alkali and acid treatment of sawdust (Millet et al; 1970). The digestibility become increase diluents to mixing of acid and alkali into sawdust. The adding reagent with sawdust NaOH and H2SO4 (Meller berger et al;1971, Butterbaugh and Johnson1974).

D.B. oke and M.O. oke (2007) the effect of feeding graded level of sawdust *Daniellia ogea* tree on the performance and carcass characteristics of broiler chickens. Experiment was investigated by the effect of sawdust obtained from *Daniellia ogea* tree were formulated with is nitrogenous (22% crude protein) and energy 2.60Kcal/g Each after experiment the daily weight gains were increased and dressing percentage, gut weight was also increased significantly.

Savory and Gentle (1976), said sawdust reduces density of diets and makes birds to consumes more feed in order to acquire enough energy for metabolic activities (Abdelsamic et al;1983 Moran1977; Fanjiyi and Ologhobo,1999;Scott et al;1992).

Sobamiwa(1993),Poultry species particularly the broiler chicks have consistency demonstrated in elastic response to dietary fiber.

Savory and Gentle1976), said Japanese quails fed on diet diluted with either oak sawdust or cellulose power(High fiber) consumed more feed than birds fed on the same diets undiluted (low fiber).

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Oluyemis J.A. and F.A. Robert, (2000) said, Fiber levels as low as 1-2% and as high as 9% (Hauseretal, 1945), have been recommended for growing broiler. Young bird can tolerate dietary fiber contain of 13 and 15% respectively for efficient functioning of their alimentary tract (Sainsbury, 1980).

(Abdelsamie et al;1983), reported that increased fiber content of diets led to increase in weight and length of gastrointestinal tract.

Zemak, B.F. B.J. Kosikova, J. Augustine and D. Joniok, (1979), Sawdust have antibiotic properties like lignin component. Inhibitory effect of compound with guaiacyl and syringyl structure representing the structure of native lignin; were studied on model cellulose of bacteria, yeast, yeast like microorganism and mould. Lignin composed exhibited the most inhibitory effect on growth of the studied microorganism.

D.A. Dinius and E.E.Williums (1975), Above scientist were made an experiment of 2,3 and 4.Atotal of 160 growing steer were group fed and abruptly switched from forage to the concentrate diet diluted with varying percentage of sawdust, fed to 5 or 10 days, and then fed only concentrate for another 10 to30 days. The steer tended to go off feed , when abruptly switched from forage to 20 to30% sawdust diets or from the 50% sawdust diet to the all concentrate diet. The sawdust were withdraw from 50% to 0% by decreasing the dietary percentage of forage while increasing the percentage of concentrate during a 10-day interval had fewer off feed problem tended to have higher weight gain for cattle the total feeding period than sawdust fed cattle. during a 10-day interval had fewer off feed problem tended to have higher weight gain for the total feeding period than sawdust fed cattle.

**Chemical composition of saw dust**

Sawdust is the main component of particle board. Nutritionally it contain 94.50% dry matter, 2.53% crude protein, 60.25% crude fiber, 0.76% either extract, 10.80%ash, 24.53%NFE (Mokhtar and S.Radwan). In addition to sawdust contain vitamin and phosphorus and mineral. It contain Calcium oil (0.11%) and phosphorus (0.02%), (Richard.S.Adans et al1997). Research journal of poultry science (2007), determined the proximate value of Ogea sawdust, Dry matter (997.200, Ash (6.40), Crude protein(8.80), Crude fiber(676.10), Either extract(14.70). All values are determined as g/kg dry matter basis.

Richard, S.Adams. Pennstate(1997), reported chemical composition of saw dust contain crude protein(1.60%), acid detergent fiber(81%), TDN(33%), Fresh or green sawdust contain 40-505 dry matter ,or kiln dried sawdust contain 85-88% dry matter.

Saw dust contain fat and lignin component which protect the plant against predators during alive condition.

Zemak .B.F.B.J kosikova, J.Augustine and Djoniok(1979), reported sawdust have antibiotic like activity which similar to lignin component. Inhibitory effect of compound with guaiacyl and syringyl structure representing the structure of native lignin.

**CHAPTER III**

**MATERIALS AND METHODS**

**Collection of sample**

Samples were collected by using simple random sampling technique. Fifteen sawdust samples of different plants were selected randomly. Approximately 500 grams of sawdust was collected as for individual plant. Sample were raped 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. Later on, it was mixed properly and exposed to shade to cool down for sampling.

**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 total ash in the animal nutrition laboratory, Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh as per AOAC (1994).

**Data analysis**

Data related to chemical composition of rice polish were compiled by using Microsoft Excel 2007. Chi-square test was performed to analyze the data by using Statistical Package for Social Sciences (SPSS 16.0). For each Chi-square test, reference value for the relative component was obtained from text book (Banerjee, 1995) to use as the test value for that particular component. Statistical significance was accepted at 5% level (P<0.05)

**Sample**

Fresh

Fresh

Fresh

Fresh

Fresh

Fresh

*Drying on hot air oven at 105 up to constant of weight at 24-48 hours. Successive drying at one hour interval.*

*Extract by Soxhlet apparatus with diethyl ether for 6-8 hours. Dry the collection flask at 100 over night.*

*Acid boiling for 30 minutes with 1.25% H2SO4 solution at constant volume. Alkali boiling for 30 minutes with 1.25% NaOH at constant volume . Burning in heater ,followed by ignition in Muffle burner for 6-8 hours.*

*Burning in electrical heater with in crucible at 115-200 up to no smoke. Ignition in muffle farness at 550-600 for 6-8 hours.*

*It is a calculative value . %NFE=100-(%CP+%MOISTURE+%CF+%EE+%Ash)*

*Digestion with concentrate H2SO4and digestion mixture keep up to clean or green residue . Distillation with 40% NaHO solution to trap the ammonia by using 2% Boric acid solution . Titration with 0.1N HCl solution.*

**DM**

**CP**

**CF**

**EE**

**Ash**

**NFE**



Figure 1: Sample collection Figure 2: DM estimation



Figure 3: Ash (Burning the sample) Figure 4: Ignition of sample for Ash



Figure 5: CP estimation (Digestion) Figure 6: CP estimation (Distillation)



Figure 7: CP estimation (Titration) Figure 8: EE estimation sample taking



Figure 9: EE estimation Figure 10: Solution for CF estimation

Figure 11: CF estimation Figure 12: CF estimation by manual

**CHAPTER IV**

**RESULT & DISCUSSION**

The chemical composition of different wood trees are shown in table 1.

**Table 1 : Chemical composition of individual sawdust (N=15)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Local Name | Scientific Name | Nutritive value% | | | | | | |
|  |  | MS | *DM* | ASH | CP | CF | EE | NFE |
| Gamari | *Gemelina arborea* | 32 | 68 | 0.75 | 0.70 | 41.09 | 1.06 | 24.4 |
| Koroy | *Samania samun* | 42 | 58 | 0.50 | 1 | 35 | 1.09 | 20.41 |
| Tiarasi | *Aphananiixis polystachya* | 22 | 78 | 0.80 | 1.05 | 60.75 | 0.15 | 15.25 |
| Jam | *Syzygium cumini* | 29 | 71 | 3 | 0.87 | 42 | 1.16 | 23.97 |
| Gudda | *Dipterocarpus costatus* | 20 | 80 | 2.8 | 1.4 | 58 | 0.98 | 16.82 |
| Phul cumary | *Dipterocarpus alatus* | 27 | 73 | 1.3 | 1.05 | 55.95 | 0.01 | 14.69 |
| Sundari | *Heritiera fomes* | 33 | 67 | 1.25 | 1.75 | 43 | 0.057 | 20.02 |
| Konok chapa | *Breguiera cylindrica* | 18 | 82 | 0.60 | 1.05 | 61 | 0.77 | 18.53 |
| Sagun | *Tecna grandis* | 23 | 77 | 5.13 | 1.57 | 56.64 | 1.67 | 12.02 |
| Kathal | *Artocarpus heterophyllus* | 13.5 | 86.5 | 7.46 | 1.05 | 41.50 | 1.88 | 36.61 |
| Sal | *Shorea robus* | 10 | 90 | 7 | 1.22 | 62.30 | 1.76 | 17.72 |
| Garjan | *Rhizophora mucronata* | 30 | 70 | 0.75 | 1.05 | 49.05 | 0.61 | 18.54 |
| Chompa phool | *Ceriops decandra* | 23 | 77 | 2.4 | 0.70 | 61.8 | 0.38 | 11.72 |
| kacu gass | *Bruguiera cylindrica* | 38 | 62 | 0.60 | 1.75 | 32.22 | 3.46 | 14.16 |
| Loha kat | *Mesua ferrea* | 16 | 84 | 1 | 1.75 | 66. | 0.41 | 23.97 |

Note: MS=Moisture; DM=Dry matter; Ash=Total Ash; CP=Crude protein; CF=Crude fiber; EE=Ether extracts; NFE=Nitrogen free extract.

In terms of moisture content, the highest was found in Koroy tree 42% & the lower in Sal tree 10%. Dry matter % high in Sal tree (90%) and low in Koroy (58%). Ash % high in kathal (7.46%) and low in koroy (0.5%). Crude protein % high in Loha kat and Kacu gass (1.75%) and low in Gamarai and champa phool (0.7%). Crude fibre % high in Loha kat (66%) and low in koroy (35%). Ether extracts % high in kacu gass (3.46%) and low in tiarasi (0.15%). Nitrogen free extracts % high in kathal (36.61%) and low in chopma phool (11.72%).

**Table 2: Mean Chemical composition of different types of sawdust(N=15)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Parameters** | **Minimum** | **Maximum** | **Mean** | **SD** | **S.E** | **Sig.** |
| Moisture (g/100g) | 10 | 42 | 25.1 | 9.04 | 2.33 |  |
| DM (g/100g) | 58 | 90 | 74.9 | 9.04 | 2.33 |  |
| CP (g/100g) | 0.70 | 1.75 | 1.20 | 0.36 | 0.09 | NS |
| CF (g/100g) | 32.22 | 66 | 51.08 | 11.07 | 2.86 |  |
| NFE (g/100g) | 11.72 | 36.61 | 19.25 | 6.29 | 1.63 |  |
| EE (g/100g) | 0.01 | 3.46 | 1.03 | 0.90 | 0.22 | NS |
| Ash (g/100g) | 0.50 | 7.46 | 2.35 | 2.34 | 0.60 |  |

***SD(Standard deviation); SE(Standard error); NS(P ; (P0.01)***

Diagramed presentation of Mean value of Moisture, DM, CP, CF, NFE, EE, Ash of sawdust:

**Figure 13: Diagrammatic presentation of Nutritive value of sawdust.**

In present study, the mean value for moisture obtained 25.1(g/100g) but in previous study ( Mokhtar and S.Radwan) found 5.5(g/100g) moister in sawdust. QURAT –UL AIN et al also obtained 7.8 (g/100g) moister in sawdust which is contradictory with the present study. It may be due to the state of sawdust during study period. In previous study they use sundry sample for proximate analysis but in present study it was fresh sample immediate after collection, so moisture percentage was found higher.

The mean value for dry matter in sawdust was obtained 74.9(g/100), which is not similar with Mokhtar and Radwan findings 94.5 (g/100g) dry matter in sawdust.

QURAT-UL AIN et al also found 92.2 (g/100g) dry matter in sawdust which is also contradictory. It was also due to high moisture content of fresh sawdust in present study compared to sundry saw dust in previous study.

In addition, the mean value for crude protein was obtained 1.20(g/100g) in sawdust. The result does not agree with Mokhtar and S. Radwan who found 2.53 (g/100g) crude protein in sawdust. The result of present study is contradictory with QURAT-UL- AIN et al who found 8.53 (g/100g) in sawdust. It may be due to the stage of maturation and also type of wood trees.

The mean value for crude fiber was obtained 51.08(g/100g). The result is somewhat dissimilar with Mokhtar and S.RADWAN et al who found 60.26 (g/100g) crude fiber in sawdust. QURAT-UL AIN et al also found 60.20 (g/100g) crude fiber in sawdust. However, the result of the current study is not similar with Dboke and Mooke et al who found 67.6 (g/100g) crude fiber in sawdust. In this case my argument is same. The obtained crude fiber of the present study is lower then the previous study which may be due to the lignifications of the fibers and also due to type of trees.

The current study determined the mean value of ether extract in saw dust was 1.03(g/100g). The result is almost similar with Mokhtar and Radwan who found the ether extract 0.76 (g/100) in sawdust. Dboke and Mooke who found 1.47 (g/100g) ether extract in sawdust. So the result of the current study is contradictory with QURAT-UL AIN et al who found 2.3 (g/100g) ether extract in sawdust.

In present study, the mean value for ash was obtained 2.35(g/100g). The result match with the findings of QURAT-UL AIN et al who found 2.2 (g/100g) ash in sawdust. But result is contradictory with Mokhtar and S. Radwan who found 10.80 (g/100g) ash in saw dust.

The mean value for nitrogen free extract was 19.25(g/100g). The result is almost similar with Mokhtar and S. Radwan who found NFE value 24.03 (g/100g).

**CHAPTER V**

**CONCLUSION**

Sawdust is a vital source of fiber for livestock. A wide range of in vivo and in vitro studies speculate that, livestock can utilize fibers available in sawdust. Additionally, it contains crude protein and ether extracts which may be used for poultry and livestock as well. Present study reveals that the quality of sawdust may vary from species to species. Therefore, it could be suggested that, sawdust should be incorporated with conventional feedstuffs at an optimal margin after laboratory analysis. However, it needs to explore more intensive studies in future to investigate sustainable methods for inclusion of this useful fiber in livestock diets.

**CHAPTER VI**

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