EFFECT OF STORAGE ON QUALITY OF COWPEA HAULM HAY UNDER WARM HUMID CONDITIONS

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ABSTRACT
The effect of four months storage on chemical composition of hay prepared from cowpea haulm was monitored in a Coastal savanna environment in Cape Coast, Ghana. The average hydrometeorological conditions during the experimental period were 27.1°C of temperature, 30.1mm of rainfall, 80.4% of relative humidity and 0.80 water activity.

Parameters measured were dry matter (DM%), crude protein (CP%), metabolisable energy for ruminants [MEr, MJME/KgDM], protein to energy ratio (p/E, g/MJME), pH, and rumen degradable nitrogen (RDN,%). The CP, MEr, P/E, pH and RDN values of 13.04%, 7.17 MJME kg^{-1}DM, 18.18g/MJME, 6.35 and 58.83% of freshly prepared hay changed to 12.05%, 6.50 MJME Kg^{-1}DM, 18.56g/MJME, 6.63 and 56.73% respectively at sixteenth week of storage.

The study indicated that cowpea haulm hay can be prepared and stored under warm humid conditions in a Coastal Savanna Ecological Zone of Ghana, which has the highest relative humidity in the country throughout the year, without much change in its nutritive value.

The implication of the study for ruminant livestock production is discussed.

KEYWORDS
Metabolizable energy for ruminants; Rumen degradable nitrogen, Nutritive value

INTRODUCTION
Livestock agriculture in Ghana has not developed to a stage where farmers practice grass land farming to produce feed for their animals. It is the existing range and farm lands which serve as grazing grounds for ruminant livestock. Therefore, avilability of fodder as feed is dictated by natural rainfall patterns, natural hazards like fire outbreaks, floods and other hydrometeorological conditions, with no man-made influences. Off and on-farm crop residues are therefore used in feeding ruminant livestock in Ghana, especially during the dry season of the year and when animals are in partial confinement.

Some crop residues used in Ghana are haulms of leguminous crops (eg cowpea, pigeon pea and groundnut) and vegetative parts of cereal crops (rice, maize, sorghum and millet) left on the field after harvesting the pods, nuts and grains.

In Ghana, the haulms of cowpea and groundnuts are left on the field after pods have been harvested to be browsed or grazed by ruminant livestock, decay to produce organic matter for soil, but accidentally or purposely. In other parts of the Sub-Saharan African countries like Northern Nigeria, Mali, Niger and Burkina Faso, cowpea and groundnut haulms are harvested, dried (processed into hay) and either used directly by the producers or sold to livestock farmers. This use of leguminous crop residues is very necessary in Sub-Saharan African countries where extensive livestock pre-dominates, and cereal fibrous by-products constitutes the bulk of feeding material using the dry season. The leguminous crop residue will be high in nitrogen compared to most straws at the time the pods are harvested, will provide organic nitrogen source, improve the nutritional status and utilization of available feeds (mainly straw during the dry season).

The objective of this study was to examine qualitative changes in the nutritive value of cowpea haulms during storage under warm humid conditions.

MATERIALS AND METHODS
Experimental Material Thirty mini sacks of fresh cowpea haulm weighing 290kg were harvested from the Teaching and Research Farm of the University of Cape Coast, Cape Coast, Ghana in December, 1993. The crop residue was chopped into lengths of 5 to 10cm, composited and sundried for six days to attain dry matter [DM] of 90.5% from initial average dry matter of 36.76%. After the sixth day of drying, a sample of the hay produced was taken for chemical analysis and the bulk stored in stacked rectangular form on wooden racks in a store. The store room has an area of 5m x 3m, dwarf wall of about 1m high and sides made up of aluminium wire mesh with holes 5cm by 5cm, cement floor and galvanised iron roof. The stored samples were analysed every 2 weeks for chemical components until the end of the 16th week storage.

Chemical Analysis The dry matter (DM), crude protein (CP), ash and pH of samples were determined by Weende Analytic methods [Close and Menke, 1986]. The metabolizable energy (MJME/KgDM) for ruminants (MEr) was determined by use of Hohenheimer Futherwert - Test (HFT) using rumen liquid as elaborated by Menke el al ., (1979) in in-vitro studies as follows:

$$MEr = 146GB + 5.7\ CP + 0.268L^{2} + 2200$$

where GB is the gas production (ml) in 24 hours from 200mg dry matter (DM) and CP, L are the crude protein (gkg^{-1} DM) and crude lipids (gka^{-1} DM) of the feeding stuff (DM basis) of Hohenheim, Germany. Rumen degradable (RDN) was estimated by using the formula.

$$RDN\ (\%) = \frac{10.7 \times 100}{P/E}$$ [Close and Menke, 1986]

where 10.7 is the minimum protein to energy ratio for efficient rumen functioning, P is crude protein content and E is the MEr.

Hydrometeorological Data The rainfall, temperature and relative humidity data used in the study were the averages of a twenty year period, 1970 - 1990, and that for the experimental period recorded at the Saltpond Meteorological Station located in the Coastal Savanna ecological zone. Evapotranspiration was calculated by Penman method (1963) and Water Activity calculated as Relative Humidity divided by 100.

RESULTS AND DISCUSSION
Hay Preparation In December 1993, preliminary studies on hay preparation were carried out and the hay stored from January to April, 1994. In Ghana, farmers plant the cowpea primarily for the seeds so the haulms can be collected after harvesting pods and suncured into hay. This is feasible in the ecological zone when the matured cowpea pods are harvested around December and January.

This is because evapotranspiration exceeds avilable rainfall, making drying possible between months of November and March [Fig. I].

Chemical Composition of Cowpea Haulm Hay A comparison of the chemical composition of the initial hay and after 16 weeks storage period (Table 1) revealed losses of 0.04 MJME of metabolizable energy for ruminants and 0.06% crude protein per week which were not significant ($P>0.05$). The negligible reduction in dry matter might be due to the high relative humidity in the area (average of 80.4%) during the study period. Loss of crude protein and metabolizable energy might be due to mechanical loss of leaves high in easily digestible nutrients due to its brittleness. Non enzymatic degradation and microbial processes within stored material could also result in the loss of crude protein and metabolizable energy for ruminants as suggested by Sundstol and Owen (1984). The high dry matter content

reduced the instability index of the stored hay thereby reducing non enzymatic degradation/microbial activities capable of using easily digestible constituents of the feed ingredients to a minimum. This might have accounted for the non significant losses in MEr and crude protein of the stored hay.

The extent of fungal growth and resulting mycotoxin levels in the store cowpea haulm hay were not investigated; though the high water activity which was above .70, coupled with high temperature (minimum 26%°C) makes the area of study favourable for fungal growth. This is because the dry matter content of the store hay (ranging from 86.92% to 90.57%) was not conducive for fungal (Aspegillus spp common in Tropical areas) growth. Muller, 1992 reported that at moisture contents of 22 to 33% and 14% for cereals, field and storage fungi can grow. Though he worked with cereals, studies could be applied to stored cowpea haulm hay.

The crude protein concentration of the cowpea haulm hay compared favourably with values of 10 to 15% for vegetative parts of pulses and leguminous crops [Sundstol and Owen, 1984] and 11.4 and 12.5% for hay of groundnut tops and cowpea haulm in Mali (Diagayete, 1981). The energy value of 7.2 MKME Kg^{-1}DM for freshly prepared hay was higher than that of pigeon pea leaves and whole plant of 6.9 and 6.4 MJME Kg^{-1} DM respectively from Thailand (DSE, 1990). The minor differences could be attributed to species, variety, proportion of leave to vines or stem, time of harvesting age and soil nutrient status as suggested by Sundstol and Owen (1984). The results of this study have shown that the Coastal Savanna ecological zone of Ghana has favourable hydro meteorological conditions for the production of cowpea haulm hay and storage for 16 weeks without deterioration of its nutritive value.

IMPLICATION OF STUDY FOR RUMINANT LIVESTOCK PRODUCTION IN GHANA

In Ghana, the greatest cowpea and other leguminous crops (groundnut) production is done in the Forest - Savanna transition and Savanna areas (GDB, 1990) which coincidentally is the area where 77% of cattle production in Ghana takes place. (APD, 1994). Small scale cowpea and groundnut farmers should therefore be educated to harvest and process cowpea haulm and groundnut tops into hay. The hay produced could be used directly for feeding their livestock or sold to ruminant livestock owners to increase their income from cultivation of these crops as it is being practised in Northern Nigeria, Niger, Mali and Burkina Faso.

The processing of cowpea haulm, other leguminous crop residues and other forages into hay will provide feed to be utilized in the dry season of the year when green feed is scarce or non existent on the natural pasture for livestock feeding. It will lead to an improvement in the productivity of ruminant livestock in Ghana, since cowpea haulm hay could be produced and stored in the Coastal Savanna ecological zone of Ghana; having the highest mean relative humidity (>70%) and high temperatures (>26.0°C) with negligible loss in nutritive value, hay could be prepared and stored in the forest savanna and savanna zones with low mean relative humidity (57%), high evapotranspiration rate of 181.6mm (minimum) and low rainfall (MSD, 1992).

TABLE 1

Chemical Composition of Cowpea Haulm Hay - Dry Matter Basis

Component	Freshly prepared Hay	Hay After 16th week Of Storage
Dry matter (%)	90.57	86.92
Crude protein (%)	13.04	12.05
Crude Ash (%)	11.50	12.50
Metabolizable energyfor ruminants MJME/kgDM	7.17	6.50
Protein to energy ratio [P/E,g/MJME]	18.18	18.56
pH	6.35	6.65
Rumen degradable Nitrogen (%)	58.83	56.73

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Figure 1

Relationship between Rainfall and Evapotranspiration on Hay Preparation (20 yr Average)