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## *Full Length Research Article*

# THE NUTRITIVE VALUE OF DIFFERENT TYPES OF WASTE PAPERS IN SUDAN

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**ABSTRACT**

Nutrition is a major constraint for animal production in the Sudan due to rangeland deterioration and seasonal variations in feeds quality and quantity with serious shortages and effects on animals' health and performance. In the dry season large amounts of different types of waste paper are available and are not properly recycled or utilized and they affect the environment. A study was conducted to determine the proximate analysis and *in vitro* gas production and predict the metabolizable energy in ten different types of waste paper including office paper. There were variations in proximate analysis, gas production and metabolizable energy among different types of waste paper. Crude protein was very low (0.3 – 0.9%) and crude fibre was high (45.95 – 58.7%) in different types of waste paper. Ash, EE and NFE varied greatly among types of waste paper. The gas production was highest in Roneo printed A4 paper and least in new newsprints. Metabolizable energy was higher in printed A4 paper (5.47- 5.56Mj/kg DM) and lowest in news prints (1.74- 2.77Mj/kg DM). The results showed that waste paper had low nutritive value and can be used as a basal diet for ruminants, especially in the dry season and droughts, and could be supplemented for better results.



## INTRODUCTION

Animal production is an important sector in the Sudan due to high population, wide distribution and socioeconomic impacts (MARF, 2008). Nutrition is one of the main constraints for animal production in the Sudan since it is mainly traditional and based on rangeland which deteriorated for many reasons (Abusuwar and Darrag, 2002). Moreover there are seasonal variations in feeds quality and quantity associated with seasonal variations in rainfall with serious feed shortages in the dry season affecting animals' health and performance (Elhag, 1992). Browses and agro-industrial by – products are important in filling the nutritional gap. There are many types of crop residues, but generally have low nutritive value due to high fibres and low CP and hence low digestibility and dry matter intake (Asma, 2007). It is important to exploit cheap unconventional feeds to fill the nutritional gap. Large amounts of different types of waste paper are available in the Sudan and are not properly recycled or utilized and their elimination has serious impacts on the environment. Waste paper is used in paper manufacturing (Amin, 1987), fibre sludge cement board (Isou *et al.,* 1998), weeds control (Smith *et al.*, 1998) and animal feed (Van Soest, 1982). Up to 24% waste paper in rations did not affect palatability and depressed intake (Dinius and Oltjen, 1973). Different raw materials are used in paper manufacturing including wood with physical and / or chemical treatments which are likely to affect their nutritive value (Amin, 1987). There are variations in the composition of different types of waste paper with generally high CF and very low CP (> 1%). Waste paper digestibility varies greatly with raw materials and processing. According to Dinus and Oltjen, (1971) mechanical pulp forms about 70% of newsprint and is less affected by chemical treatments and has a digestibility similar to wood. The chemical pulp is highly delignified and almost completely digestible (up to 98%). Furthermore, ground newsprint absorbed about three times its weight molasses, palatable and can be used as molasses carrier. Ink, which may contain lead, has no serious effects on cattle since it does not accumulate to noticeable levels in animals (Anonymous, 2002). Information on the nutritive value of different types of waste paper in the Sudan and abroad is

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scarce. Consequently, two experiments were conducted to determine the composition and in *vitro* gas production and then to predict the metabolizable energy of different types of waste paper.

## MATERIALS AND METHODS

The experiment was conducted in the premises of the Goat Research Centre in Wad Medani, Gezira State, Sudan. Ten different types of waste paper were collected and properly sampled including office paper (original and computer or Roneo printed), newsprint (new, shaded or sun exposed), glossy magazines, cement brown packing paper and ordinary and glossy cardboard.

**Experiment I:** The proximate analysis of different types of waste paper.

Each types of waste paper was shredded and analyzed in duplicates for dry matter (DM), crude protein (CP), crude fibre (CF), ether extract (EE) and ash as described by AOAC (1990). Nitrogen free extract was calculated by difference (Van Soest, 1982).

**Experiment II:***In vitro* gas production and metabolizable energy of different types of waste paper.

I*n vitro* gas production was determined in different types of waste paper as described by (Menke *et al.,* 1979). The rumen fluid was collected from two rumen fistulated cows about 5 years old at the Animal Research Centre in Hellat Kuku, Khartoum North, Sudan. They were fed sorghum straw *ad lib.* And Berseem (*Medicago sativa*) in two equal meals at 8.00 a.m. and 4.00 p.m.. The rumen fluid was collected an hour before the morning feeding.

The metabolizable energy (ME) was calculated from the chemical composition (CP, CF and EE) and *in vitro* gas production (Menke *et al.,* 1979).

**Statistical analysis:** The results were analyzed using analysis of variance and Duncan's test (Gomez and Gomez, 1979).

## RESULTS

The proximate analysis of different types of waste paper is shown in Table 1. There were significant differences in the composition of different types of waste paper. Dry matter was high in all types of wastepaper. Crude protein was very low (<1%) with significant differences among some types of wastepaper. There were great and significant variations in EE among types of waste paper and was highest in the cardboard. Crude fibre was generally high with great and significant differences among types of waste paper and was highest in cement brown packing paper and least in glossy newsprint. There were great and significant differences in ash among different types of waste paper and was highest in the Roneo typed A4 paper and glossy newsprint and least in newsprint, except the glossy one. Nitrogen free extract varied greatly and was highest in newsprint and least in cement brown packing paper. Table 2 shows actual and corrected mean *in vitro* gas production and predicted ME in different types of waste paper. The corrected gas production was generally lower than the actual with significant differences among types of waste paper. Corrected values were highest in computer and Roneo printed A4 paper followed by the glossy cardboard and was least in the new newsprint. Predicted ME varied significantly among types of wastepaper and the ranking order was generally similar to the corrected gas production. The computer and Roneo typed A4 paper had the highest mean gas production, ME and CF and newsprint had the least gas production, ME and ash and high CF.

**Table 1.The proximate analysis (%) of different types of waste paper in the Gezira, Sudan**

| Types of paper | DM | CP | EE | CF | Ash | NFE |
|---|---|---|---|---|---|---|
| A4 | 96.38$^{ab}$ | 0.80$^{a}$ | 3.50$^{b}$ | 58.70$^{b}$ | 17.99$^{b}$ | 19.01$^{e}$ |
| Computer printed A4 | 98.20$^{a}$ | 0.80$^{a}$ | 3.50$^{b}$ | 58.70$^{b}$ | 17.99$^{b}$ | 19.01$^{e}$ |
| Roneo printed A4 | 97.36$^{ab}$ | 0.89$^{a}$ | 2.05$^{c}$ | 58.64$^{b}$ | 32.10$^{a}$ | 19.01$^{e}$ |
| New newsprint | 95.56$^{b}$ | 0.69$^{b}$ | 3.30$^{b}$ | 58.25$^{b}$ | 01.86$^{de}$ | 35.87$^{c}$ |
| Shaded old newsprint | 96.41$^{b}$ | 0.90$^{a}$ | 2.45$^{c}$ | 57.30$^{c}$ | 00.73$^{e}$ | 38.62$^{b}$ |
| Sun exposed newsprint | 96.11$^{b}$ | 0.03$^{d}$ | 2.43$^{c}$ | 50.45$^{e}$ | 01.07$^{e}$ | 46.02$^{a}$ |
| Glossy newsprint | 96.72$^{b}$ | 0.89$^{a}$ | 2.05$^{c}$ | 45.95$^{f}$ | 32.10$^{a}$ | 19.01$^{e}$ |
| Cement packing | 96.33$^{b}$ | 0.33$^{c}$ | 3.42$^{b}$ | 77.40$^{a}$ | 2.22$^{d}$ | 16.63$^{f}$ |
| Ordinary cardboard | 94.97$^{b}$ | 0.89$^{a}$ | 4.45$^{a}$ | 54.90$^{d}$ | 6.91$^{c}$ | 32.85$^{d}$ |
| Glossy cardboard | 96.01$^{b}$ | 0.89$^{a}$ | 4.45$^{a}$ | 54.90$^{d}$ | 6.91$^{c}$ | 32.85$^{d}$ |

DM= Dry matter, CP= Crude protein, CF= Crude fibre, EE= Ether extract, NFE= Nitrogen free extract.

**Table 2.In vitro gas production and predicted metabolizable energy of different types of waste paper in the Gezira, Sudan**

| Types of waste paper | Actual gas volume | Corrected gas volume | ME (MJ/Kg DM) |
|---|---|---|---|
| A4 Paper | 20.00±3.8 | 16.57 | 3.92±0.4 |
| Computer printed A4 paper | 34.00±3.8 | 27.67 | 5.47±0.4 |
| Roneo printed A4 paper | 34.25±3.8 | 28.33 | 5.56±0.4 |
| New newsprint paper | 01.00±3.8 | 00.87 | 1.74±0.4 |
| Shaded old newsprint paper | 05.00±3.8 | 04.19 | 2.18±0.4 |
| Sun exposed newsprint paper | 03.50±3.8 | 02.92 | 2.01±0.4 |
| Glossy newsprint paper | 10.35±3.8 | 08.49 | 2.77±0.4 |
| Cement packing paper | 19.00±3.8 | 15.83 | 3.81±0.4 |
| Ordinary cardboard | 19.50±3.8 | 16.27 | 3.86±0.4 |
| Glossy cardboard | 25.50±3.8 | 21.37 | 4.61±0.4 |

ME= Metabolizable energy.

## DISCUSSION

The variations in the proximate analysis of different types of waste paper in the Gezira were similar to that reported for office paper and newsprint (Anonymous, 2002) and were mainly due to variations in raw materials, processing and environments. The high DM in waste paper is expected since processing involves drying and the variations among them are mainly due to differences in raw materials, processing and affinity to absorb moisture. The results showed that waste paper is a poor source of CP and mainly fibres and N should be added for proper exploitation in ruminants. The low CP was similar to that reported for office paper and newsprint (0.7%) (Anonymous, 2002). The great variations in EE among types of waste paper were similar to that in office paper (1.9%) and newsprint (3.7%) (Anonymous, 2002). Office paper had relatively high EE than the reported in the literature (1.9%) (Anonymous, 2002) and could be due to variations in raw materials and processing. Ether extract in the new newsprint was close to that in the literature (3.7%). The results demonstrated that CF is the main component of different types of waste paper because wood was the main raw material.

The great variations among types of waste paper were due to variations in raw materials and processing and fibres were treated physically by grinding and drying and may be chemically which are likely to improve the nutritive value. The crude fibre in newsprint and A4 was generally lower than the reported (68.9% and 83.8%, respectively) (Anonymous, 2002) and could be due to different raw materials and processing. The results showed that glossy newspaper had lower CF than other newsprint and are likely to have better nutritive value. The relatively higher ash in Roneo printed and glossy newsprint and the least in newsprint (except the glossy) could be due to types of ink. Ash in office paper (5.5%) (Anonymous, 2002) was about 30% of that in A4 paper. The reported ash in newsprint (0.9%) was relatively higher than that for the shaded and less than other newsprint in this study. The results suggested that ash level was not serious expect in the Roneo typed and glossy print and is not likely to affect the animal health.

The variations in NFE among different types of waste paper were mainly due to raw materials and processing and were not very high since they were mainly fibre. The relatively higher NFE in newsprint suggested it as an alternative feed for ruminants and nitrogen should be added. Nitrogen free extract in this study was higher than that for office paper (8.1%) and newsprint (25.8%) reported by Anonymous (2002) and may be due to variations in raw materials and processing. The variations in gas production and ME among types of waste paper are mainly due to raw materials and processing which are known to influence the nutritive value of waste paper (Nishimuta *et al.,* 1969) and *in vitro* digestion (Coombe and Briggs, 1974). Dry matter digestibility of newsprint was about 30% and was 40 – 60% for brown raping paper and cardboard and up to 98% for high quality chemical pulp paper (Anonymous, 2002). The ME of different types of waste paper is very low indicating low nutritive value and should be properly supplemented.

### Conclusion

The results showed that waste paper had high CF and very low CP and should be supplemented for ruminants and further research is required to study intake, rumen fermentation, metabolism and effects on animal physiology, health and performance.

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