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# *In vitro* assessment for prebiotic potentials of some carbohydrates/fibrous feedstuffs fed in broiler diets

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## Background

- When dietary proteins are metabolized within the hindgut the resultant amino acids may be incorporated directly into microbial proteins or fermented as an energy source with by products of branched chain fatty acids, amines, phenols, indoles and ammonia.
- Positive correlations between microbial growth, ammonia utilization and prebiotics in form fermentable carbohydrates in the hindgut have informed this study.

## Materials and methods

- Samples were pre-digested with pepsin and pancreatin to simulate digestion in the foregut (Savoie and Gauthier, 1986). CP of the samples, dialysate and residues were determined.
- Inoculum was prepared from fresh ceacal content of broiler birds fed a diet free of antibiotics, copper and the test ingredients and a nitrogen free anaerobic medium, a modification of William et al., 2005.
- 100mg of “pre-digested” samples were incubated in 50ml syringes with 20mls inoculum at 39$^{0}$C for 72 hours. This experiment was run thrice using inoculum from birds at 4, 6 and 8 weeks of age.
- Gas production data were taken and fitted to a monophasic model (Groot *et al*., 1996).
- DM, ash, pH and ammonia were determined.
- Data were subjected to analysis of variance and means separated using Duncan’s multiple range test (SAS, 1999)

## Results and discussions

- Pre-digestion with pepsin and pancreatin (Table 1) resulted in DM digestion ranging from 168 g/kgDM to 544.4 g/kgDM guaranteeing hat all samples will resist gastric acidity and enzymatic hydrolysis up to 45-83 % *in vivo*.
- Only four samples were fermentable by intestinal microbiota of broiler birds at all ages (Table 2) which could be due to solubility of their constituent NSP fractions, degree of ligninification , origin/source of NSPs, processing methods, and presence of antinutritional factors.
- Time lag reduced significantly with age of birds owing to increased microbial diversity in the caecum. And differed significantly among substrates owing to their varied chemical compositions.
- The four samples showed significant effects on pH and ammonia production confirming a proliferation of saccharolytic microbes to the detriment of putrefactive microbes.
- Fermentation kinetics parameters infer that all substrates will ferment in different segments of the hindgut, maintaining the required pH and ammonia levels.

## Conclusion

- Cassava root sieviette, cassava starch, sweet potato flour and cassava starch residue, can control proteolytic kinetics , lowering ammonia and pH in the hindgut thus creating an inconducive environment for proliferation of pathogenic microbes.

Table 1: Crude protein (CP) of samples, DM of digested sample, CP digestion residue and crude protein digestibility.

| | CP content (g/kgDM) | DM digested (g/kgDM) | CP residue (g/kgDM) | CP digestibility (%) |
|---|---|---|---|---|
| Maize bran | 115.3 | 544.4 | 104.9 | 9.0 |
| Wheat offal | 184.1 | 457.0 | 155.1 | 15.8 |
| Rice bran | 96.3 | 168.0 | 42.6 | 55.8 |
| Distillers dried grain | 264.5 | 251.8 | 262.7 | 0.7 |
| †Root peel | 113.8 | 368.9 | 76.1 | 33.1 |
| †Root sieviette | 41.6 | 346.8 | 20.2 | 51.4 |
| †Starch | 24.1 | 344.0 | 15.8 | 34.4 |
| †Starch residue | 43.8 | 389.4 | 11.7 | 73.3 |
| PKC(se) | 224.3 | 192.7 | 147.3 | 34.3 |
| Sweet potato | 28.4 | 372.9 | 24.7 | 13.0 |

† root peel, root sieviette, starch and starch residue are products of cassava processing

Table 2: Fermentation kinetics and end product characteristics of carbohydrate samples using inoculum from broiler birds at 4, 6 and 8 weeks of age.

| Birds age | | Lag time (hrs) | DMCV | $T_{max}$ | $R_{max}$ | $NH_3$ | pH | OM loss |
|---|---|---|---|---|---|---|---|---|
| 4 | RS | 41.25$^{a}$ | 1.20$^{c}$ | 41.19$^{a}$ | 1.07$^{c}$ | 249.5 | 6.68$^{a}$ | 47.57$^{d}$ |
| | CS | 24.00$^{c}$ | 9.18$^{a}$ | 23.87$^{b}$ | 6.82$^{a}$ | 429.8 | 6.59$^{c}$ | 84.36$^{a}$ |
| | SP | 25.88$^{c}$ | 4.75$^{b}$ | 25.75$^{b}$ | 3.36$^{b}$ | 290.3 | 6.64$^{b}$ | 55.75$^{c}$ |
| | SR | 35.50$^{b}$ | 9.22$^{a}$ | 19.30$^{c}$ | 5.94$^{a}$ | 299.5 | 6.45$^{d}$ | 75.54$^{b}$ |
| | SEM | 0.44 | 0.49 | 0.65 | 0.19 | 40.60 | 0.00 | 0.21 |
| 6 | RS | 6.00$^{c}$ | 5.48$^{d}$ | 11.35$^{d}$ | 0.73$^{c}$ | 49.90 | 6.78$^{a}$ | 30.09$^{c}$ |
| | CS | 10.00$^{b}$ | 14.49$^{a}$ | 18.28$^{c}$ | 1.97$^{a}$ | 53.23 | 6.58$^{c}$ | 86.16$^{a}$ |
| | SP | 21.00$^{a}$ | 7.50$^{c}$ | 32.52$^{a}$ | 1.21$^{b}$ | 39.97 | 6.76$^{b}$ | 57.05$^{b}$ |
| | SR | 9.00$^{b}$ | 11.13$^{b}$ | 23.41$^{b}$ | 1.06$^{b}$ | 28.92 | 6.63$^{b}$ | 60.71$^{b}$ |
| | SEM | 0.29 | 0.22 | 3.55 | 0.06 | 4.77 | 0.01 | 2.56 |
| 8 | RS | 6.00$^{c}$ | 7.83$^{b}$ | 18.74$^{bc}$ | 6.00$^{b}$ | 11.91$^{ab}$ | 6.19$^{a}$ | 33.47$^{d}$ |
| | CS | 18.00$^{a}$ | 10.00$^{a}$ | 23.52$^{ab}$ | 7.75$^{a}$ | 7.21$^{b}$ | 5.61$^{b}$ | 91.91$^{a}$ |
| | SP | 18.00$^{a}$ | 9.95$^{a}$ | 28.82$^{a}$ | 7.07$^{ab}$ | 13.61$^{a}$ | 6.19$^{a}$ | 65.68$^{c}$ |
| | SR | 12.00$^{b}$ | 9.95$^{a}$ | 14.18$^{c}$ | 5.86$^{b}$ | 5.95$^{b}$ | 5.75$^{b}$ | 79.34$^{b}$ |
| | SEM | 0.00 | 0.04 | 0.21 | 0.21 | 1.03 | 0.02 | 0.85 |

Rmax = Maximal rate of gas production (ml/h); Tmax= Time at occurrence of maximal rate of gas production (h); DMCV= Dry matter cumulative gas production (ml/100mgDM); SEM= Standard error of mean; RS= Cassava root sieviette; CS= Cassava starch; SP=Sweet potato flour; SR= Cassava starch residue Means with different superscripts in each column differ significantly ($p<0.05$).

### References

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