Impact of drying on in vitro gas production of rice straw and dry matter intake of heifers

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INTRODUCTION

Rice is the third largest cereal crop (FAO, 2004) but it creates the largest amount of crop residues, rice straw has traditionally been considered to have little economic value as animal feed.

- **Due to recent price increases of feed commodities, and seasonal shortages of forages, rice straw can potentially be a source of fiber for the dairy industry.**

Although rice straw has low nutritional value, which is higher in the standing (i.e., growing) plant. While this has been accepted by rice farmers for millennia, this reduction in nutritive value has never been documented or quantified, although Sharif (1983) reported higher intake and digestibility of standing grain-free rice plants versus dried rice straw.

Robinson and Nader (2007) evaluated field scale straw maceration methods to reduce the particle size of rice straw to improve its digestibility and voluntary DM intake. However, it increased neither.

The objectives of this study were to quantify the reduction of *in vitro* gas production of rice straw post harvest and determine voluntary dry matter intake of rice plants from standing fresh to dry forage by heifers.

MATERIAL AND METHODS

In Vitro Study

Straw from two varieties of rice (M202 – a short stem variety, and M401 – an older long stem variety) were collected from fields on a commercial rice farm in California, USA.

- **Straw samples were collected by manual harvest on days 14, 10, 6, 4 and 2 pre-harvest and days 1, 2, 3, 4, 6, 8, 12, 19 and 33 post-harvest**
- **Samples were chopped to between 2-3 mm and analyzed for *in vitro* gas production within 3 hours of harvest as the fresh material**

In Vivo Study

- **Rice plants were hand harvested and grain removed.**
- **On days -11 to 10 relative to harvest, rice plants were fed daily to heifers, and voluntary intake was recorded**

RESULTS

IN VITRO

Table 1. Gas production of the two varieties (i.e., M202 and m401) on the three stages (i.e, Pre, DD, and D)[1]

	Variety			Stage[1]				*P*		
Gas	M202	M401	SEM	Pre	DD	D	SEM	Variety	Stage	var*stage
4 h	**27.1**	**23.2**	0.68	**26.5**	**24.2**	**24.7**	0.65	**<0.01**	**0.02**	**NS**
24 h	**126.5**	**113.1**	2.1	**132.4^{ab}**	**115.2^{a}**	**111.8^{b}**	2.0	**<0.01**	**<0.01**	**NS**
72 h	**188.2**	**171.0**	3.1	**189.9^{ab}**	**175.8^{a}**	**173.2^{b}**	2.9	**<0.01**	**<0.01**	**NS**
b	**200.0**	**183.3**	3.3	**197.8**	**190.6**	**186.5**	3.0	**0.01**	**0.02**	**NS**
k	**0.0407**	**0.0367**	0.0019	**0.042**	**0.037**	**0.037**	0.002	**NS**	**NS**	**NS**

Figure 1. Gas produced from 4h to 24h (calculated as the difference between 24 and 4h of incubation).

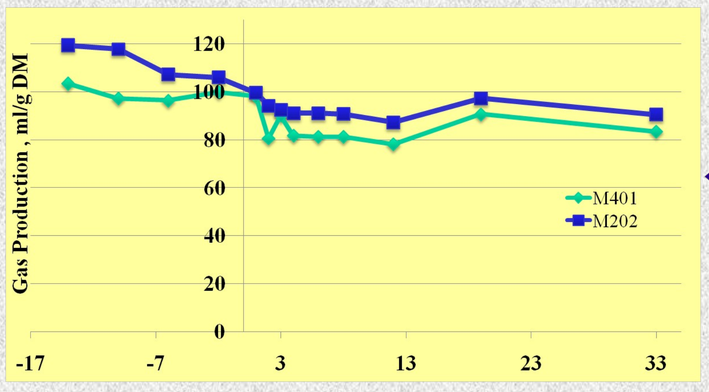

Figure 2. Gas production of the two varieties (i.e., M202 and m401) on the three stages (i.e., Pre, dd, and d)

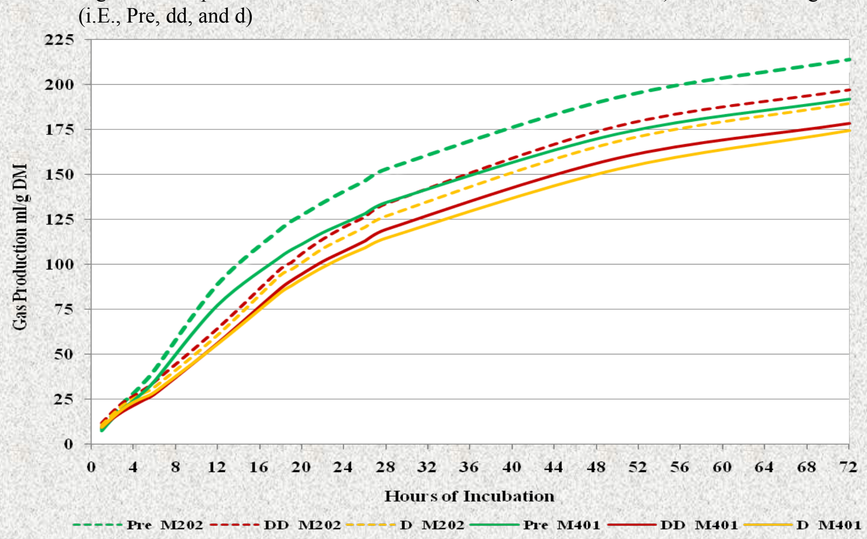

Table 2. The chemical components (g/kg dm) of rice varieties M202 and M401 pre harvest, during dry down and as dry straw

	Variety			Stage[1]				*P*		
	M202	M401	SEM	Pre	DD	D	SEM	var	stage	var*stage
CP	**4.2**	**3.8**	0.14	**4.3**	**3.9**	**3.9**	0.13	**NS**	**0.04**	**NS**
NDF	**60.6**	**61.2**	0.45	**61.3**	**60.8**	**60.5**	0.40	**NS**	**NS**	**NS**
ADF	**44.5**	**47.3**	0.22	**45.6**	**46.0**	**46.0**	0.28	**<0.01**	**NS**	**0.03**
Lignin(sa)	**3.4**	**3.8**	0.057	**3.6**	**3.7**	**3.5**	0.070	**<0.01**	**NS**	**NS**

IN VIVO

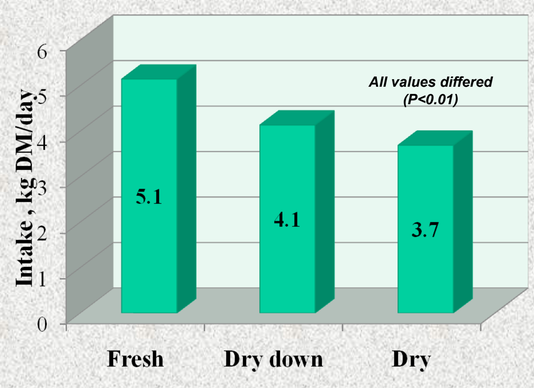

Figure 2. Dry matter intake of rice straw from day -11 to 10 relative to harvest by heifers

CONCLUSIONS

Gas production for M202 was constantly higher than M401 suggesting that the newer shorter varieties have higher nutritive value

Rice straws lost 13 to 20% of their 4-24 h gas production post-harvest, although the shape of the decline varied by variety.

Decreased in voluntary intake of 28.2 % with dried straw versus fresh rice plants supports the in vitro results and are in accordance with Sharif's work suggesting decreased palatability and decreased digestibility of rice plants from fresh to dry plants

Although gas production from 4 to 24 h of incubation is correlated to fiber digestion there was no effect of stage on fiber content suggesting that rice straw undergoes changes during drying that are not identified by traditional chemical assays, but that reduce its fermentability.

References

- **Nader, G. and Robinson, P.H. 2008. Effects of maceration of rice straw on voluntary intake and performance of growing beef cattle fed rice straw based rations. Anim. Feed Sci. Technol. 146, 74-86.**
- **Food and Agriculture Organization of the United Nations, 2004. Statistical Databases. FAO, Rome, Italy.**
- **Sharif, Z.A., 1984.The utilization of fresh and stored rice straw by sheep. School of Agriculture and Forestry, University of Melbourne**

[1] pre, fresh plants sampled before harvest; DD, rice plants sampled during the drying down period after harvesting; D, rice plants sampled during the storage of rice straw