Effects of different growth height on the yield, chemical composition, silage fermentation profile *in vitro* and *in situ* digestibility of *Broussonetia papyrifera*

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Background & Objective: *Broussonetia papyrifera* (BP) is a woody roughage source that is widely distributed in China. The chemical composition of BP may change dramatically with different growth heights (GH). The experiment was conducted to explore the effects of different GH on the BP yield, chemical composition, silage fermentation profile, as well as ruminants *in vitro* and *situ* digestibility of different parts of BP.

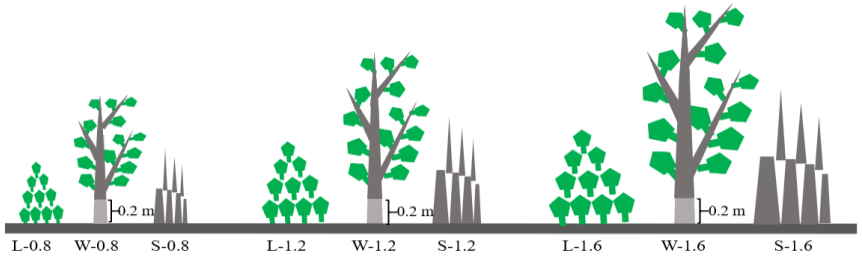

Figure1. The diagrammatic drawing of harvest method

L-0.8: leaf-growth height 0.8 m; L-1.2: leaf-growth height 1.2 m; L-1.6: leaf-growth height 1.6 m; W-0.8: whole plants-growth height 0.8 m; W-1.2: whole plants-growth height 1.2 m; W-1.6: whole plants-growth height 1.6 m; S-0.8: stem-growth height 0.8 m; S-1.2: stem-growth height 1.2 m; S-1.6: stem-growth height 1.6 m. All of them were harvest with 0.2 m cutting height.

Materials & Methods: The three different harvested GH of BP were 0.8, 1.2, and 1.6 m, respectively. Samples from leaf, stem, and whole plant of BP were collected (each one has three replicates), making silage, and detected the nutritional composition, silage fermentation profile of them. Fresh samples and silage of the leaf, stem, and whole plant at a GH of 1.2 m were obtained for the *in vitro* fermentation experiment. The *in situ* dry matter (DM), crude protein (CP), natural detergent fiber (NDF), and acid detergent fiber (ADF) degradation of the leaf, stem, and whole-plant silage at a GH of 1.2 m were determined with three fistulated cows which were in mid lactation.

Results & Discussion: Fresh weight and DM yield increased with the GH increased (P<0.001). With the increase of GH, NDF of BP increased, while CP content decreased (P<0.05). Stem had the highest NDF and ADF content, and the lowest CP content and buffer capacity.

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Table 1: Yield (per tree), chemical composition and fermentation profile of different GH of BP

Items[1]	Parts[2]	Groups 0.8	1.2	1.6	SEM[3]	*P*
FW yield (kg)	L	0.85^{bB}	1.70^{aB}	1.76^{aC}	0.15	<0.001
	S	0.47^{cC}	1.17^{bC}	2.38^{aB}	0.28	<0.001
	W	1.37^{cA}	2.79^{bA}	3.38^{aA}	0.41	<0.001
DM yield (kg)	L	0.18^{bB}	0.41^{aB}	0.43^{aC}	0.04	<0.001
	S	0.09^{cC}	0.30^{bC}	0.77^{aB}	0.10	<0.001
	W	0.27^{cA}	0.72^{bA}	1.22^{aA}	0.14	<0.001
CP (g/kg DM)	L	319^{aA}	241^{bA}	207^{cA}	16.64	<0.001
	S	131^{aC}	84.91^{bC}	52.23^{cC}	11.53	<0.001
	W	208^{aB}	169^{bB}	106^{cB}	14.95	<0.001
NDF (g/kg DM)	L	428^{bB}	447^{bC}	534^{aC}	18.97	0.019
	S	658^{bA}	681^{bA}	758^{aA}	15.64	<0.001
	W	464^{cB}	503^{bB}	668^{aB}	31.42	<0.001
ADF (g/kg DM)	L	235^{C}	239^{C}	227^{C}	4.21	0.549
	S	530^{cA}	566^{aA}	552^{bA}	5.54	0.001
	W	343^{bB}	349^{bB}	384^{aB}	6.83	0.001
pH	L	5.71^{bA}	5.09^{cA}	6.33^{aA}	1.78	<0.001
	S	4.48^{aC}	3.81^{bC}	3.86^{bC}	1.07	<0.001
	W	4.95^{aB}	4.81^{aB}	4.59^{bB}	2.08	0.024
AN (g/kg TN)	L	41.93^{C}	37.36^{B}	65.04^{A}	6.31	0.158
	S	98.92^{aA}	20.93^{bC}	32.35^{bB}	12.28	<0.001
	W	73.67^{aB}	66.85^{bA}	39.31^{cB}	11.43	<0.001
LA (g/kg DM)	L	48.04^{B}	52.15^{B}	47.42^{C}	2.83	0.802
	S	65.23^{bA}	75.71^{bA}	91.89^{aA}	4.19	0.003
	W	41.19^{bB}	48.27^{bC}	64.47^{aB}	5.58	0.002
AA (g/kg DM)	L	9.32^{cC}	39.57^{aA}	24.71^{bA}	4.43	<0.001
	S	35.36^{aB}	6.37^{bB}	13.37^{bB}	4.56	<0.001
	W	52.29^{aA}	47.13^{aA}	22.47^{bA}	5.07	0.006
PA (g/kg DM)	L	14.78^{A}	21.04^{A}	19.17^{A}	1.44	0.177
	S	2.84^{B}	1.34^{B}	1.27^{B}	1.12	0.156
	W	14.45^{aA}	12.84^{abA}	6.54^{bB}	1.57	0.038
BA (g/kg DM)	L	ND	ND	7.03^{a}	1.63	0.043
	S	ND	ND	ND		
	W	ND^{B}	3.39^{A}	ND^{B}	0.70	0.084

Means within the same row with different letters are significantly different (P<0.05).
Values with different lowercase superscript letters (a, b, and c) are significantly different (P<0.05) between different growth heights (0.8, 1.2, and 1.6). Values with different uppercase superscript letters (A, B, and C) are significantly different (P<0.05) between different parts (L, S, and W).
[1] FW: fresh weight; DM: dry matter; CP: crude protein; NDF: neutral detergent fiber; ADF: acid detergent fiber; AN/TN: NH3-N to total N ratio; LA: lactic acid; AA: acetic acid; PA: propionic aid; BA: butyric acid; ND: no detection.
[2] L: leaf; S: stem; W: whole plant.
[3] SEM: standard error of measurement.

Results and Discussion: The BP silage fermentation quality was deteriorated (lactic acid content decreased and pH values increased) with GH increased. Leaf silage had the highest pH and stem silage had the highest lactic acid content (P<0.05). The leaf and its silage had the highest *in vitro* DM digestibility and gas production compared to others. The BP *in situ* digestibility were corresponded with *in vitro* results.

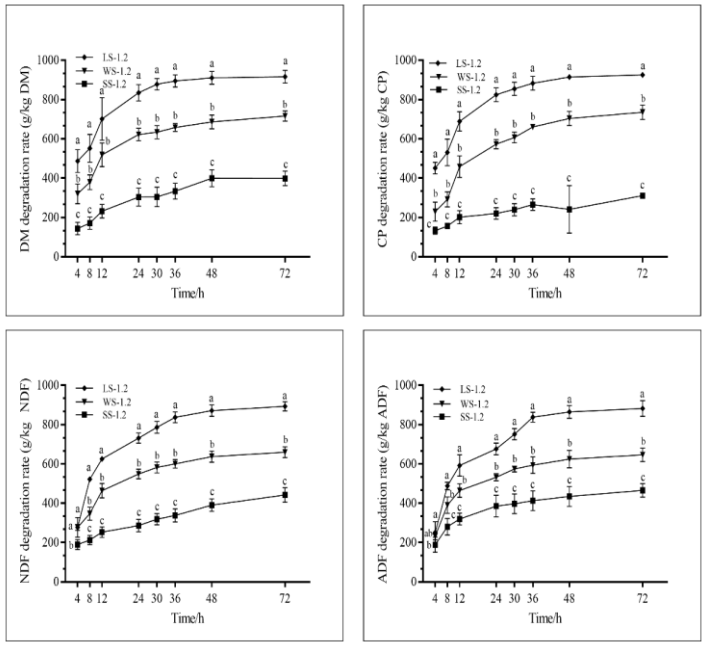

Figure 2. The real-time degradation rates of different parts BP silage in rumen

Means within the same time point with different letters are significantly different (P<0.05).
LS-1.2: leaf silage with a 1.2 m growth height; SS-1.2, stem silage with a 1.2 m growth height; WS-1.2: whole plant silage with a 1.2 m growth height.
DM: dry matter; CP: crude protein; NDF: neutral detergent fiber; ADF: acid detergent fiber.

Conclusion and Acknowledgements: BP is a high protein content roughage source. The nutritional quality decreased with GH increased and it could be used as a potential feedstuff for ruminants. We thank the CARS-36 for their financial support.