Sheep Recognize Chewing Easiness of Grass Leaves Prior to Prehension through Sensing Bending Strength

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Sheep recognize chewing easiness of grass leaves prior to prehension through sensing bending strength

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Introduction Grazing animals choose plant parts which can be eaten quickly with ease . Grazing animals usually remove only uppermost parts of plants because of different resistances to defoliation imposed by the physical structure of plant tissue . The objective of this study is to clarify the effect of bending and shearing strengths of orchardgrass leaves on foraging behavior and analyze biting forces and impulse created by sheep .

Materials and methods Grazing trials were carried out using two Suffolk wethers aged 1 .5 years . The same sward board previously reported by Hongo et al . (2004) and Hongo et al . (2007) was used for artificial construction of swards . During the grazing trials , fresh leaves of orchardgrass was cut in the early morning . Each leaf blade was clipped into three parts (basal , middle and apical parts) . Five and ten leaves per loadcell were offered to sheep . Three-directional biting forces were measured when sheep foraged leaves . After grazing trials , bending , tensile and shearing strengths of leaves were measured . Bending strength (S) was given by the expression :

$$S = F_{max} L/4$$

where F_{max} is the maximum bending force and L is the span distance between two supports .

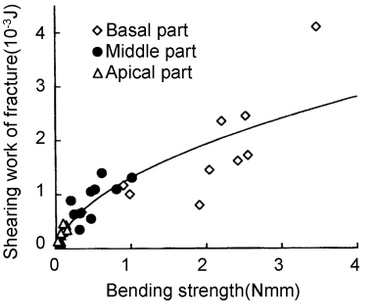

Figure 1 *Relationship between bending strength and shearing work of fracture at basal ,middle and apical parts of orchardgrass leaves . Correlation equation was as follows :*
$Y = 1.5 X^{0.5} - 0.19$
$(r = 0.87 , df = 28 , p < 0.001)$

Results and discussion Total leaf length was 641 ± 26 mm . There were significant differences between three parts with respect to leaf width , thickness of midrib and cross-sectional area .

All mean values of biomechanical properties were significantly higher in the basal part than in the apical part , except tensile stress . Tensile stress was not significantly different between three parts . There was a significant correlation between bending strength and shearing work of fracture (Figure 1) . It has been suggested that shearing property may be important during chewing of leaves . It strongly suggests that sheep *may recognize chewing easiness of leaves prior to prehension through sensing bending strength bite and adjust leaf number into a mouth and biting force . This hypothesis was supported by the result that* 72 % of total 427 bites were completed by only one peak biting force .

Sum of biting impulse was significantly different between three parts . Sum of biting impulse was 3 .3 and 4 .7 times higher at the middle and basal , respectively , than that at the apical part (Figure 2) .

To assess the benefit/cost ratio in foraging behaviour , intake efficiency (DM weight per biting impulse) was calculated (Figure 2) . The intake efficiency was significantly higher at the apical part than the middle and basal parts .

Biting force per one leaf created by sheep was 4 .0-10 .5 N . Tensile strength of one leaf was 17-69 N and shearing strength of one leaf was 1 .3-4 .4 N . These results suggest that sheep could break-down leaves principally by shearing force .

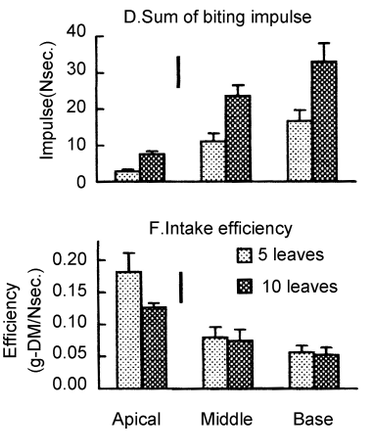

Figure 2 *Sum of biting impulse and intake efficiency (DM weight per biting impulse) in foraging basal ,middle and apical parts of orchardgrass leaves .*

Conclusions Sheep may recognize chewing easiness of leaves prior to prehension through sensing bending strength bite and adjust leaf number into a mouth and biting force .

At prehension , sheep may break-down leaves principally by shearing force .

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