Accumulation of polyphenols and major bioactive compounds in *Plantago lanceolata* L. as a medicinal plant for animal health and production

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Introduction Producing animals without the use of feed-grade antibiotic growth promoters and chemical medicines is sought. Scientific studies with this aim have focused on medicinal plants to identify and quantify any beneficial effects that they might have on animal production. *Plantago lanceolata* L. has been used in herbal medicines and is currently being evaluated as a potential pasture species because of its beneficial effects on animal health. In the present study, the accumulation of polyphenols in *P. Lanceolata* is compared to that in principal pasture species, and genetic variation and environmental changes in the major bioactive compounds in *P. Lanceplata* are investigated.

Materials and methods The total polyphenol content of plantain leaves was determined using the Folin-Denis method, and was compared to the values for the following principal pasture species: *Dactylis glomerata* L., *Phleum pratense* L., *Lolium perenne* L., *Phalaris arundinacea* L. and *Trifolium repens* L.. The catalpol, aucubin and acteoside contents of two varieties and one ecotype of *P. lanceolata* were quantitatively determined using high-performance liquid chromatography (HPLC) of plant samples obtained throughout the growing season (Tamura & Nishibe, 2002), and under different environmental and cultivation conditions.

Results The highest total polyphenol content was observed in *P. lanceolata*, and was up to twice that of the average value for the pasture species tested (Figure 1). The aucubin and acteoside contents were relatively high, and significant genetic variation was detected within the cultivars and in comparison with the ecotype (Figure 2). By contrast, the catalpol content was low and this compound was absent from one variety. Plants grown under a high light intensity with a low nitrogen fertiliser application accumulated greater amounts of these compounds.

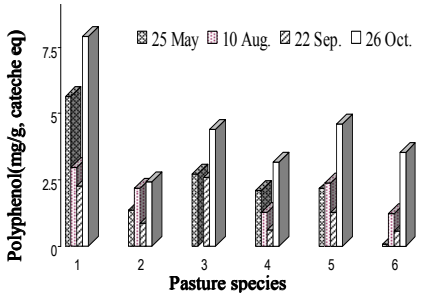

Figure 1 Polyphenol content of *P. lanceolata* and Pastures
Note: 1; *Plantago lanceolata* L., 2; Dactylus glomerata L., 3; Phleum pratense L., 4; Lolium perenne L., 5; Phalaris arundinacia L., 6; Trifolium repens L.

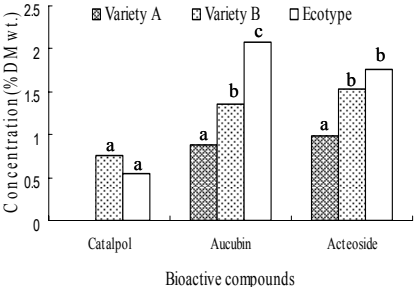

Figure 2 Bioactive compounds in leaves of varieties and ecotype of *Plantago lanceolata* L.
Note: Different letters indicate statistically significant differences between groups at the 5% level

Conclusions *P. lanceolata* accumulated greater amounts of polyphenols than the principal pasture species, and significant genetic variation was observed in the levels of bioactive compounds. Several previous studies have examined the effect of *P. lanceolata* on animal health and meat quality, and have reported positive effects, such as a decreased n-6/n-3 fatty-acid ratio in chickens, and decreased blood glucose levels and a higher meat grade in pigs. Further studies will be necessary to clarify the precise effects of bioactive compounds on animals.

References

Tamura, Y. & N. Sansei (2002). Changes in the contents of bioactive compounds in plantain leaves. *Journal of Agricultural and Food Chemistry,* 50, 2514-2518.