



## Nutritional value of aquatic ferns (*Azolla filiculoides* Lam. and *Salvinia molesta* Mitchell) in pigs

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### Abstract

Aquatic ferns (AFs) such as *Azolla filiculoides* and *Salvinia molesta* are grown on swine lagoons in the tropics and used to feed pigs. The present work aimed to determine their nutritional value. *Azolla* samples collected in Colombian pig farms contained from 184 to 317 g crude protein/kg DM, 469–620 g NDF and 98–145 g ash. Those of *Salvinia* contained from 112 to 169 g crude protein/kg DM, 518–629 g NDF and 161–232 g ash. The content in all macro- and micro-minerals were high and exceeded the pig's requirements expressed per kg diet. The proteins of the two species presented a similar amino acid profile and contained from 47 to 53 g lysine/kg protein, 11–17 g methionine, 53–55 g threonine and 14–15 g tryptophan. A digestibility study in 60 kg pigs was carried out with diets containing maize, soybean meal, minerals and 0, 125 or 250 g AF/kg diet. The weight and length of the digestive organs was also measured. The presence of AF decreased the faecal digestibility of crude protein, NDF and gross energy of the diet ( $P < 0.001$ ). The ileal protein digestibility decreased ( $P = 0.03$ ) with the increase in AF level in the diet. The digestible energy content per kg AF, calculated

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by difference between the basal diet and that of the diet containing 125 g AF/kg was 10.76 MJ/kg DM for *Azolla* and 6.58 MJ/kg DM for *Salvinia*. AF intake did not affect the gastrointestinal tract, with the exception of an increase in the length and weight of the colon of pigs fed 250 g AF/kg diet ( $P < 0.01$ ). In conclusion, *Azolla* and *Salvinia* are good sources of minerals and essential amino acids but their interest is limited in pig production by their low digestible energy and protein content.

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## 1. Introduction

Aquatic ferns (AF) have become a nuisance in many tropical regions of the world. They invade aquatic habitats, form dense mats on slow-moving water bodies, clog irrigation canals and have deleterious effects on water utilization and on the biodiversity of aquatic biosystems (McConnachie et al., 2004). On the other hand, they constitute an interesting element of sustainable agricultural systems. *Azolla* species, for example, are floating ferns with symbiotic N<sub>2</sub>-fixing cyanobacteria that are widely used in Asia to fertilize rice fields. They are also used as green manure and as water purifiers, thanks to their capacity to retain large amounts of minerals (Arora and Singh, 2003). *Azolla* productivity can reach 40 t DM/(ha year) (Becerra et al., 1990) whereas that of *Salvinia* ranges from 45 to up to 110 t DM/(ha year) (Mitchell and Tur, 1975).

Aquatic plants such as *Azolla*, *Salvinia* and *Lemna* are also integrated in animal production systems. They grow on lagoons that collect pig slurry and are later used to feed the pigs.

However, despite the fact that millions of smallholders feed their pigs with aquatic plants in the world, especially in Asia, virtually no information is available on their nutritional value. The aim of the present work was to determine the composition and nutritional value of two AF in pigs: *Azolla filiculoides* Lam. and *Salvinia molesta* Mitchell.

## 2. Material and methods

### 2.1. Production of aquatic plants

AF were produced at the experimental farm of the National University of Colombia, campus of Palmira and in a commercial farm (Pozo Verde, Jamundi, Colombia). Both are located in the Cauca river valley between the Western and the Central Andes. The average diurnal temperature ranges from 24 to 30 °C and the total rainfall reaches 1000 mm water/year in Palmira and 1800 mm/year in Jamundi. In Palmira, three consecutive lagoons ( $\pm 100$  m<sup>2</sup> each) were used to collect the whole manure coming from the pig experimental unit (15 pigs). *Lemna minor* L. was grown on the water surface of the first lagoon, used to collect directly the manure. The liquid fraction in excess was evacuated by gravity to two successive lagoons, on which respectively *Salvinia* and *Azolla* were grown. Every 1–2 weeks, roughly three quarters of the lagoon surface were harvested and the plants were kept

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