Rev Iberoam Micol. 2015;32(4):252–256

Revista Iberoamericana de Micología

www.elsevier.es/reviberoammicol

Original article

Nematophagous fungi from decomposing cattle faeces in Argentina

Carlos Alfredo Saumell[a,*], Alicia Silvina Fernández[b,1], Luis Alberto Fusé[a], Manuela Rodríguez[a], María Federica Sagüés[a], Lucía Emilia Iglesias[a]

[a] Área de Parasitología y Enfermedades Parasitarias, Departamento de Sanidad Animal y Medicina Preventiva (SAMP), Facultad de Ciencias Veterinarias (FCV), Universidad Nacional del Centro de la Provincia de Buenos Aires (UNICEN), Centro de Investigación Veterinaria de Tandil (CIVETAN) – CONICET, Paraje Arroyo Seco, B7000 Tandil, Argentina
[b] BioNem Research Centre, 44 Kipling Ave., Guelph N1H 8C2, Ontario, Canada

ARTICLE INFO

Article history:
Received 7 October 2013
Accepted 16 September 2014
Available online 7 January 2015

Keywords:
Nematophagous fungi
Diversity
Ecology
Decomposing faeces
Fungal colonisation

ABSTRACT

Background: Biological control of gastrointestinal nematodes of ruminants by use of nematophagous fungi would become part of any livestock parasite integral control system. Identifying autochthonous species that could then be selected for mass production is an important phase in the practical use of biological control.
Aims: To search for nematophagous fungi with potential use as biological control agents against gastrointestinal nematodes in Argentina.
Methods: Decomposing cattle faeces sampled in different locations were incubated in water agar 2% with *Panagrellus* sp. The developed nematophagous fungi were transferred to new water agar 2% plates and then to corn meal agar plates in order to carry out their identification. Fungal diversity and richness were also assessed.
Results: Seventeen species from nine genera of nematophagous fungi were found. Twelve species were nematode-trapping fungi and three species plus two fungi identified to genus level corresponded to endoparasitic fungi. *Arthrobotrys conoides, Arthrobotrys oligospora, Duddingtonia flagrans, Monacrosporium doedycoides, Arthrobotrys robusta* and *Drechmeria coniospora* were the most frequently isolated species overall in the whole study (6.6%, 5.7%, 5.7%, 5.7%, 4.7% and 4.7%, respectively) although other species were more frequently recorded at local levels such as *Arthrobotrys pyriformis* (18.8%). Only *A. conoides* has been previously isolated from ruminant faecal samples in Argentina. Five nematode-trapping fungal species are mentioned for the first time in the Americas
Conclusions: *D. flagrans* and *A. conoides*, both identified in the present study, are among the most promising ones as biological control agents against gastrointestinal nematodes of ruminants.

Hongos nematófagos en heces bovinas en descomposición en Argentina

Palabras clave:
Hongos nematófagos
Diversidad
Ecología
Heces en descomposición
Colonización fúngica

RESUMEN

Antecedentes: El control biológico de los nematodos gastrointestinales de los rumiantes mediante hongos nematófagos es una herramienta a considerar en los sistemas integrados de control parasitario del ganado. La identificación de las especies autóctonas de estos hongos que puedan ser seleccionadas para producción masiva es de gran importancia en el uso práctico del control biológico.
Objetivos: Llevar a cabo una búsqueda de hongos nematófagos de uso potencial como agentes de control biológico contra nematodos gastrointestinales en Argentina.
Métodos: Se trabajó con muestras de heces bovinas en descomposición obtenidas en diferentes lugares. Las heces se incubaron en agar agua 2% con *Panagrellus* sp. Los hongos nematófagos desarrollados se transfirieron a nuevas placas con agar agua 2% y luego a placas con agar harina de maíz para su identificación. También se estableció la diversidad y riqueza fúngicas.

* Corresponding author.
E-mail address: saumell@vet.unicen.edu.ar (C.A. Saumell).
[1] Current address: Área de Parasitología y Enfermedades Parasitarias, Departamento de Sanidad Animal y Medicina Preventiva (SAMP), Facultad de Ciencias Veterinarias (FCV), Universidad Nacional del Centro de la Provincia de Buenos Aires (UNICEN), Centro de Investigación Veterinaria de Tandil (CIVETAN) – CONICET, Paraje Arroyo Seco, B7000 Tandil, Argentina.

http://dx.doi.org/10.1016/j.riam.2014.09.003
1130-1406/

Resultados: Se aislaron diecisiete especies de hongos nematófagos, comprendidas en nueve géneros. Doce resultaron ser hongos depredadores, mientras que otras tres especies y dos hongos identificados hasta género eran hongos endoparásitos. *Arthrobotrys conoides, Arthrobotrys oligospora, Duddingtonia flagrans, Monacrosporium doedycoides, Arthrobotrys robusta* y *Drechmeria coniospora* fueron las especies más aisladas más en todo el estudio (6.6%, 5.7%, 5.7%, 5.7%, 4.7% y 4.7%, respectivamente), aunque otras especies aparecieron más frecuentemente de manera local, como *Arthrobotrys pyriformis* (18.8%). Solamente *Arthrobotrys conoides* se había aislado previamente en Argentina a partir de heces bovinas. Cinco especies depredadoras se mencionan por primera vez en toda América.
Conclusiones: D. flagrans y *A. conoides*, dos de las especies aisladas en el presente estudio, se encuentran entre las más prometedoras como agentes de control biológico de nematodos gastrointestinales de rumiantes.

Gastrointestinal parasitosis in livestock is a serious health problem in a variety of production systems. Resistance to conventional anthelmintics,[2,5,13,47] the enforcement of strict limits for drug residues in food, and the environmental impact of the widespread use of antiparasitic drugs[14,15,17,21,22,49] emphasise the need for implementing alternative tools in the fight against parasitosis. Biological control of gastrointestinal parasites is a promising alternative to tackle this problem. It is based upon the idea of exploiting parasites' natural enemies to interfere with their natural cycles.[27]

Biological control by use of nematophagous fungi is considered to be part of parasite integral control systems. Among these fungi, Duddingtonia *flagrans* is one of the most promising species.[27] Cosmopolitan nematophagous fungi colonise soils rich in organic matter under different temperature and humidity conditions, thus contributing to the biological equilibrium of the soil by interacting with local microflora and microfauna. They are usually isolated from soil and faeces from different animals.

A number of studies have been performed in different world eco-regions to identify nematophagous fungi. The search for nematophagous fungi with potential use in biological control in agriculture and livestock production in the Americas includes, among others, Mahoney & Strongman[30] in Canada, Lappe and Ulloa[26] and Acevedo-Ramírez et al.[1] in Mexico, Búcaro[4] in El Salvador, Orozco,[35] Soto-Barrientos et al.[45] and Peraza-Padilla et al.[36] in Costa Rica, Persmack et al.[37] in Costa Rica, Nicaragua and Panama, Rubner[39] in Ecuador, and Saumell[41] and Saumell et al.[42] in Brazil. Gamundí and Spinedi[18] is the only study to date describing the presence of nematophagous fungi such as nematode-trapping and endoparasitic ones (note: egg- and cyst-parasitic fungi and toxin-producing fungi are not the focus of the present study).

The aim of this study was to search for nematophagous fungi with potential use as biological control agents against gastrointestinal nematodes in Argentina, and classify them taxonomically. The search for these fungi in cattle faeces from the main livestock regions in Argentina will contribute to identify autochthonous species naturally colonising bovine faeces. The most efficient of those species, provided that they resist laboratory manipulation, could then be selected for mass production and formulation for practical use in livestock.

Materials and methods

Sampling and isolation of fungi

Samples of decomposing cattle faeces naturally voided were collected from September to November in two consecutive years. The collection sites were commercial cattle farms close to the following cities: Tandil (37°19′18″ S, 59°04′50″ W) and Azul (36°49′01″ S, 59°50′05″ W) in Buenos Aires province; Reconquista (29°09′41″ S, 59°42″21′ O) in Santa Fe province; Río Cuarto (29°45'44″ S, 63°27'29" W) in Córdoba province; Resistencia (27°27′5″ S, 58°59′12″ W) in Chaco province; and Victoria (30°59′6″ S, 57°55′12″ W) in Entre Ríos province (Fig. 1). Samples from Tandil included as well those collected at the University Campus of the Faculty of Veterinary Sciences, National University of Central Buenos Aires Province. Subsamples of approximately 2 g were incubated at room temperature (20–24 °C) in Petri dishes containing water agar 2% that had been previously inoculated with *Panagrellus* sp. to promote fungal growth. The plates were regularly checked for three weeks under optical microscope with magnification capacity up to 100×, after which the nematophagous fungi that had developed were transferred to similar plates (water agar 2% plus *Panagrellus* sp.). Once the presence of fungal conidia or zoospores – depending on the fungi – had

Fig. 1. Map of Argentina showing the sampling sites where decomposing cattle faeces were collected. Each black circle represents one sampling site: 1: Resistencia (27°27′5″ S, 58°59′12″ W), Chaco province; 2: Reconquista (29°09′41″ S, 59°42′21″ O), Santa Fé province; 3: Victoria (30°59′6″ S, 57°55′12″ W), Entre Ríos province; 4: Río Cuarto (29°45'44″ S, 63°27'29" W), Córdoba province; 5: Azul (36°49′01″ S, 59°50′05″ W) and 6: Tandil (37°19′18″ S, 59°04′50″ W), Buenos Aires province.