Protocol for the systematic review of strategies used in beef cattle to prevent or control internal or external parasites

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Authors' contributions

Samuel Agbese: development of search strategy/protocol, preparation and review of manuscripts, extraction of data

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Heather Ganshorn: development/conducting search strategy, editing of manuscript

M. Claire Windeyer: supervising graduate student and project, funding acquisition, development of search strategy and protocol, reviewing of articles (third reviewer for resolving conflicts), and editing of manuscript.

Registration

This protocol will be published with Systematic Reviews for Animals and Food (http://www.syreaf.org/) online and documented in the University of Calgary Digital Repository (https://prism.ucalgary.ca). It will be reported using the approved PRISMA-P guidelines (Moher D et al., 2015).

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INTRODUCTION

Rationale

A common strategy of controlling both internal and external parasites of grazing cattle has been the use of chemotherapeutic drugs (i.e. anthelmintics). Largely because of the remarkable developments in these products in terms of efficacy, safety, spectrum of activity, and relative low cost, cattle producers have relied almost exclusively on their use (Waller, 1993). The widespread use of chemotherapeutics (Hein and Harrison, 2005), often in combination with inadequate management practices (Wolstenholme et al., 2004), has resulted in parasites starting to develop resistance to the available drugs. With the increasing problem of resistance and efforts to support sustainable ways of farming, the search for more comprehensive methods of parasite control has become necessary (Thamsborg et al., 2010). Schemes that integrate several different parasite control strategies that are practically, financially, and economically feasible are the only way to ensure long-term sustainability (Waller, 2006). A number of reviews have shown the current scientific knowledge of strategies to prevent and control parasites in sheep and goat farming systems, but there is paucity of information on the scientific knowledge that summarizes the recommended strategies for implementation on beef cattle operations to prevent and control internal and external parasites.

OBJECTIVES

This paper describes the protocol for a systematic review that will evaluate the following question: What strategies are most effective for the prevention or control of internal or external parasites in beef cattle herds? The overall objective of this systematic review is to critically assess and synthesize the current published knowledge on the aforementioned review question.

METHODS

Eligibility criteria

The review question follows the PICO framework (i.e. Population, Intervention, Comparison Group, and Outcome; Sargeant and O'Connor, 2020). The study characteristics derived from this framework are represented below.

Table 1: Study characteristics for the systematic review on strategies used in beef cattle to prevent or control internal or external parasites

Study characteristic	**Description**
Population	Beef cattle; calves, sucklers, backgrounders, stockers, feeders, heifers, steers, bulls, and cows
Intervention	Parasite control strategies
Comparison group	Observational studies: Unexposed group Randomized control trial (RCT): Control/placebo group
Outcome	Prevention or control of internal or external parasites

Population: Eligible studies will focus on beef cattle (calves, backgrounders, stockers, feeders, heifers, steers, bulls, and cows). Articles on dairy or veal cattle and related species such as buffalo, bison, or yaks will be ineligible.

Intervention: Selected studies will address various parasite control strategies implemented on beef cattle operations, including but not limited to pasture management, biosecurity measures, pharmaceutical use, and genetic interventions.

Outcome: Studies will be eligible if parasite control strategies are targeted at preventing or controlling internal or external parasites.

Study designs and language: Studies with experimental trials or observational designs (e.g. studies done in a pen or field setting) will be included. Articles without abstracts or available full text will be excluded. Additionally, studies not available in a language known to the authors (i.e. English) or articles not easily translated into English using Google Translate will be excluded.

Sources of information

The search will be performed in the following databases: MEDLINE on the Ovid platform, Web of Science, CAB Abstracts, Scopus, and ProQuest Dissertations. All the search strategies used on each database will be recorded.

Search strategy

CAB abstracts

#	Query	Results
S1	(DE "beef cattle" OR DE "beef herds" OR DE "suckler herds")	26,368
S2	TI ((beef OR suckler*) AND (cattle OR cow* OR heifer* OR steer* OR stocker* OR bull* OR feeder* OR "cow-calf")) OR AB ((beef OR suckler*) AND (cattle OR cow* OR heifer* OR steer* OR stocker* OR bull* OR feeder* OR "cow-calf"))	39,693
S3	S1 OR S2	48,124
S4	DE "animal parasitic nematodes" OR DE "entomophilic nematodes" OR DE "lungworms" OR DE "helminths" OR DE "hookworms" OR DE "liver flukes" OR DE "lungworms" OR DE "Bunostomum" OR DE "Bunostomum phlebotomum" OR DE "Trichostrongylus" OR DE "Oesophagostomum" OR DE "Oesophagostomum columbianum" OR DE "Oesophagostomum radiatum" OR DE "Trichuris" OR DE "Strongyloides" OR DE "Haemonchus" OR DE "Haemonchus contortus" OR DE "Haemonchus placei" OR DE "Haemonchus similis" OR DE "Ostertagia"	249,047
S5	DE "Moniezia benedeni"	232
S6	DE "Ostertagia ostertagi" OR DE "Cooperia oncophora" OR DE "Cooperia punctata" OR DE "Nematodirus helvetianus"	1,594
S7	DE "Dictyocaulus viviparus" OR DE "Fascioloides magna"	1,663

S8	eimeria OR coccidia	16,787
S9	DE "Stomoxys calcitrans" OR DE "Haematobia irritans" OR DE "Haematobia irritans exigua" OR DE "Haematobia irritans irritans" OR DE "Hypoderma bovis" OR DE "Hypoderma lineatum"	358
S10	DE "Bovicola bovis" OR DE "Linognathus vituli" OR DE "Haematopinus eurysternus" OR DE "Solenopotes capillatus"	3,323
S11	simulium OR boophilus OR Rhipicephalus	15,174
S12	TI (parasit* or nematod* or GIN or helminth* or worm* or roundworm* or ostertagi* or cooperia or lungworm* or "dictyocaulus viviparous" or flatworm* or fluke* or fascioloides or tapeworm* or coccid* or Eimeria or lice or louse or "damalinia bovis" or "bovicola bovis" or "linognathus vituli" or "haematopinus eurysternus" or "solenopotes Capillatus" or fly or flies or "stomoxys calcitrans" or "haematobia irritans" or "cattle grub*" or tick* or trychostrongyl* or bunostonum or Oesophagostomum or trichuris or strongyl* or haemonch*) OR AB (parasit* or nematod* or GIN or helminth* or worm* or roundworm* or ostertagi* or cooperia or lungworm* or "dictyocaulus viviparous" or flatworm* or fluke* or fascioloides or tapeworm* or coccid* or Eimeria or lice or louse or "damalinia bovis" or "bovicola bovis" or "linognathus vituli" or "haematopinus eurysternus" or "solenopotes Capillatus" or fly or flies or "stomoxys calcitrans" or "haematobia irritans" or "cattle grub*" or tick* or trychostrongyl* or bunostonum or Oesophagostomum or trichuris or strongyl* or haemonch*)	557,286
S13	S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12	661,199
S14	DE "anthelmintics" OR DE "ivermectin" AND DE "benzimidazoles" OR DE "fenbendazole" OR DE "oxfendazole" OR DE "albendazole" OR DE "moxidectin" OR DE "doramectin" OR DE "eprinomectin" OR DE "abamectin" OR DE "benzimidazole" OR DE "fenbendazole"	45,885
S15	TI (control* or manag* or burden or preven* or treat* or endectocide* or ant*helmint* or deworm* or ivermectin or benzimidazole or moxidectin or doramectin or eprinomectin or abamectin or macrocyclic lactone or ricobendazole or levamisole or albendazole or fenbendazole or "rotational grazing" or "pour-on" or drench* or "spot-on" or insecticid* or parasiticid* or "anti- parasit*") OR AB (control* or manag* or burden or preven* or treat* or endectocide* or ant*helmint* or deworm* or ivermectin or benzimidazole or moxidectin or doramectin or eprinomectin or abamectin or macrocyclic lactone or ricobendazole or levamisole or albendazole or fenbendazole or "rotational grazing" or "pour-on" or drench* or "spot-on" or insecticid* or parasiticid* or "anti- parasit*")	3,680,890
S16	(DE "insecticides" OR DE "arsenical insecticides" OR DE "bacterial insecticides" OR DE "botanical insecticides" OR DE "carbamate insecticides" OR DE "dinitrophenol insecticides" OR DE "fluorine insecticides" OR DE "formamidine insecticides" OR DE "fumigant insecticides" OR DE "fungal insecticides" OR DE "helminth insecticides" OR DE "insect growth regulators" OR DE "organochlorine insecticides" OR DE "organophosphorus insecticides" OR DE "pyrethroid insecticides" OR DE "unclassified insecticides" OR DE "viral insecticides" OR DE "antibiotic insecticides") OR (DE "antiparasitic agents")	136,836
S17	S14 OR S15 OR S16	3,710,479
S18	S3 AND S13 AND S17	1,370

Record management

Covidence (Veritas Health Innovation, Melbourne, Australia) will be used to manage records retrieved from all searches. Duplicates will be identified and removed during the file importing process by the same software. Abstract and complete screening will be recorded in Covidence. In Microsoft Excel (Microsoft Corporation, Redmond, WA), extraction of data and the assessment of the risk of bias will be documented. STATA 16.1 software (StataCorp LP, College Station, Texas) will be used if statistical analysis is to be carried out.

Selection of studies

Studies will be screened in two stages. In the initial stage, all titles and abstracts will be screened using the inclusion/exclusion criteria by at least two independent reviewers using Covidence. A reference will be excluded when there is evidence that one or more inclusion criteria are not met. The agreement among the reviewers will be assessed by selecting the first 10% of the citations entering each stage of the process before screening all papers. Any disagreements will be resolved through discussion and a third reviewer will assess any unresolved conflicts. In the final stage, the retained references will be further screened by reading the materials and methods section of the full text by a single independent reviewer (SA), supervised by the senior author (CW).

Initial stage

- Does the title/abstract refer to a primary research study published in a peer-reviewed journal?
- Does the title/abstract refer to beef cattle (calves, backgrounders, stockers, feeders, heifers, steers, bulls, and cows)?
- Does the title/abstract refer to a parasite control strategy of interest?

Criteria to exclude studies

Dairy or veal cattle and related species such as buffalo, bison, or yaks

Criteria to include studies

Beef cattle (calves, backgrounders, stockers, feeders, heifers, steers, bulls, and cows), parasite control strategies of interest, internal or external parasites.

'Yes', 'No', and 'Maybe' are the possible answers to the above questions. Studies for which the answer is 'No' to any of the three questions will be excluded. Studies for which the answer is 'Yes' or 'Maybe' to all three questions will be retained for the next screening phase (modified from Dohoo et al., 2009; Sargeant and O'Connor, 2020).

Final stage

During the final stage of full-text screening, studies will be screened using the following questions:

- Does the study design describe an RCT or an observational study?
- Does the study report a comparison or control group where no treatment or intervention was given to beef cattle?
- Does the study describe the prevention or control of internal or external parasites as an outcome?
- Does the study make reference to beef cattle (i.e. calves, backgrounders, stockers, feeders, heifers, steers, bulls, and cows)?

Studies for which the answer is 'Yes' to all four questions will be retained for data extraction and risk of bias assessment.

Data extraction

A single reviewer (SA) will perform data extraction independently, under the supervision of an additional reviewer (CW). Data to extract will include: Publication details (title of a study, author(s), publication year, language, country/geographical area), study design, population of the animals (beef cattle), population characteristics (breed, sex, age, production group), type of outcome (prevention or control of parasites), and type of intervention (various parasite control strategies).

Outcome and prioritization

The primary outcome of interest will be the prevention or control of internal or external parasites.

Risk of bias assessment

Risk of bias of each selected study will be assessed qualitatively as low, high, or unclear (i.e. not enough information supplied to determine the risk of bias) based on 3 domains (i.e. selection bias, information bias, confounding) from the Cochrane Review Handbook (Sargeant and O'Connor, 2014). The overall risk of bias will be determined using the highest category assigned in any of the domains. Risk of bias will be carried out independently by two reviewers, and any disagreement between reviewers will be resolved through discussion as a team.

i. *Sample selection bias*

Selection bias occurs when there are systematic differences in sample characteristics and sampling methods between control and intervention groups or observational groups (Dohoo et al., 2009), and it will be assessed using the following question: *1. Were cattle assigned to control/intervention or observational groups differently from each other? and 2. Did methods of sampling vary systematically between control and intervention or observational groups?*

Examples of high risk of sample selection bias:

- Beef cattle allocated to control/intervention or observational groups were of different breeds.
- Beef cattle allocated to control/intervention or observational groups came from different herds unless herd is the observational unit.

ii. *Information bias*

Information bias occurs when there are systematic differences in the ways by which information on exposure/treatment, outcomes, or both were collected (Aschengrau and Seage, 2020). This domain will be assessed using the following question: *Were outcomes of interest obtained in a way that ensures correctness across the control/intervention or observational groups?*

High risk of information bias examples:

- Farm investigators were not blinded to treatment assignment.
- Methods used to prevent and control internal and external parasites were not carried out in such a way that assure truthfulness in the outcome.

iii. Confounding

Confounding is a systematic error that occurs due to mixing of the exposure effect with other additional factors resulting in distortion in the outcome measure (Dohoo et al., 2009). This domain will be assessed using the following question: *Were appropriate measures put in place to lower potential confounding in the study?*

Examples of high risk of confounding include:

- Treatment was not randomly assigned to beef cattle or herds.
- Farm characteristics such as management practices that may be regarded as potential confounding variables were not matched between the control/intervention or observational groups.
- No statistical approaches were applied to control for potential confounding variables.

Evidence Synthesis

The data extracted from this review will be synthesized narratively. A meta-analysis will be performed if there is enough data from a sufficient number of homogeneous studies with low risk of bias.

Conclusion

Deviations to this protocol will be documented in the final narrative review. The purpose of this systematic review is to critically examine and summarize the literature on the use of various parasite control strategies to prevent or control internal and external parasites in beef cattle. The results of this systematic review could help inform beef producers and veterinarians by summarizing the evidence for the use of parasite control strategies to prevent and control parasites in beef cattle operations, in addition to highlighting areas where future research is needed.

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