

Article

## Anthelmintic Effect of Caprine Milk: A Systematic Review

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**Abstract**— Novel alternative compounds for the treatment of soil-transmitted helminths are urgently needed due to the development of resistance to chemotherapy. Many screen plants for anthelmintic activity, but animal-based products are also potential sources for medicine. For example, caprine milk is a popular drink much coveted for its nutraceutical effect. However, the anthelmintic activity of caprine milk is not known. The present study utilizes a systematic review of the literature to identify any anthelmintic effect of caprine milk from Scopus, Medline, Ovid, Embase, Cinahl and Web of Science databases. Of the 355 titles produced by the bibliographic search only 3 manuscripts were included in this review. Our systematic review found very limited evidence of caprine milk having any anthelmintic effect. It highlights the need for a more focused and rigorous work on the anthelmintic effect of caprine milk.

**Keywords**— Systematic; review; caprine; milk; anthelmintic

### I. INTRODUCTION

Soil-transmitted helminth infection is a global affliction which affects humans and potentially results in significant global disease burden [1]. It also affects livestock, resulting in significant economic losses [2]. Chemotherapy carried out based on limited available classes of anthelmintic is losing efficacy in humans and it has caused resistance to be developed in animals [3] [4]. Hence, alternative novel classes of anthelmintic are urgently needed. Many have already begun exploring the potential of various plants for anthelmintic activity with cysteine proteinases from papaya, pineapple and figs found to be promising [5]. Animals also have been proven to be effective sources for medicine. For example, bovine and camel milk have shown considerable anthelmintic efficacy [6]-[8]. However, the anthelmintic mechanism of those milk is not known, but the roles of proteinaceous components [6] as well as lactoferrin [7] have been proposed. Goats (*Capra hircus*), in comparison to cattle and camels, are easily cultivated and they do not require expensive infrastructure, making them the animal of choice for socioeconomic sustenance, especially in the developing world. Caprine milk is a popular drink in many parts of the world, besides being very nutritious it has been shown to be antibacterial [9], antiviral and antifungal in nature [10]. However, its anthelmintic activity is not known. Thus, this study aimed to conduct a systematic review to investigate whether there is any evidence of anthelmintic activity of caprine milk.

### II. THE MATERIAL AND METHOD

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#### A. Methodology

A systematic scientific review of the available literature using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines [11] was performed in December 2019 to identify any scientific article documenting anthelmintic effect of caprine milk (Figure 1).

#### B. Search Strategy and Selection Criteria

The search included the following databases: Scopus<sup>®</sup>, MEDLINE<sup>®</sup> Complete, Ovid<sup>®</sup>, EMBASE<sup>®</sup>, Web of Science<sup>™</sup> and CINAHL<sup>®</sup> Complete. Boolean search statements, namely, (**caprine\* AND milk\***) AND (**goat\* AND milk\***) AND **ant\*helmintic\*** were used on all platforms, for all databases. In addition, manual search using Google search engine and checked references in some review articles was done for additional related articles. Resulting abstracts were compiled using the Endnote library software. No time limits were defined and all articles published in English were selected

### C. Identification of Relevant Studies and Data Extraction

All manuscripts from searches were downloaded into Endnote library. Potentially relevant papers were selected by screening the titles (first step), abstracts (second step) and the entire article (third step) retrieved from the database searches. Two researchers (F.A.F.M. and F.H.A.) independently conducted this screening based upon inclusion and exclusion criteria. Data were extracted from the included studies and summarised into table 1.

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### E. Summary measurement

Findings were reported via narrative synthesis. Meta analysis was not attempted due to heterogeneity of studies.

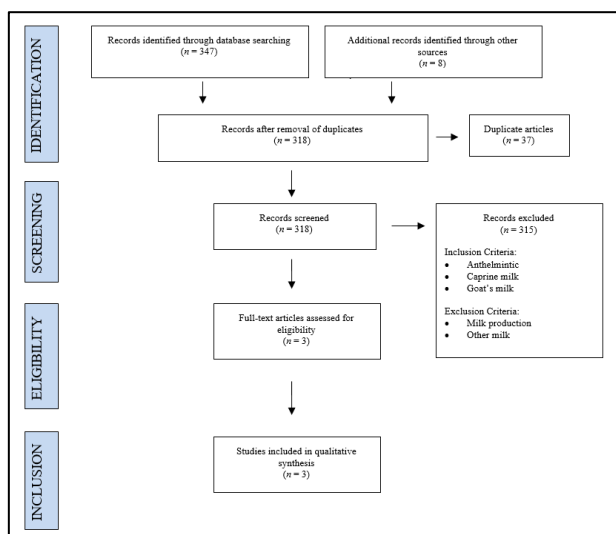


Figure 1: PRISM Search Strategy Flow Diagram

TABLE 1  
CHARACTERISTICS OF INCLUDED STUDIES

Author & Year	Type of caprine milk used	Type of study	Experimental design	Type of parasite used	Parameter	Results
Alimi <i>et al.</i> , 2016	raw	<i>In vitro</i>	<i>Egg hatch assay</i> Worm ova incubated in different concentrations of caprine milk	<i>Haemonchus contortus</i>	Egg hatch percentage	Fresh caprine milk demonstrated weak dose dependant ovicidal activity with only 9% inhibition at the highest concentration of 100mg/ml and 4% inhibition at the lowest concentration of 6.25mg/ml.
Alimi <i>et al.</i> , 2018	Kefir (a type of fermented yoghurt drink).	<i>In vitro</i>	<i>Egg hatch assay</i> Worm ova incubated in different concentrations of caprine milk kefir (0.015,0.03,0.06,0.135,0.25) mg/ml	<i>Haemonchus contortus</i>	Egg hatch percentage	Caprine milk kefir demonstrated a substantial dose dependant ovicidal effect with the highest inhibition of 88% at a concentration of 0.25mg/ml and the lowest inhibition of 10% at a concentration of 0.03mg/ml, and no inhibition at 0.015mg/ml
		<i>In vitro</i>	<i>Motility assay</i> Adult worms incubated in different concentrations of caprine milk kefir (0.125, 0.25, 0.5) mg/ml	<i>Haemonchus contortus</i>	Mortality percentage	Caprine milk kefir demonstrated a 100% mortality rate by 8hrs incubation at 0.5mg/ml concentration while the lowest concentration of 0.125mg/ml only resulted in 45.3% mortality rate by 8 hrs.
Najm <i>et al.</i> 2018	Raw	<i>In vitro</i>	Transmission electron micrographic study	<i>Ancylostoma caninum</i>	Ultrastructural change observation	Caprine milk demonstrated potent anthelmintic activity damaging worm cuticle and hypodermic ultrastructures.

### III. RESULTS AND DISCUSSION

The electronic search resulted in a total of 347 abstracts on the related topic. An additional 8 abstracts were found through hand search via Google search engine and related references, making the total count 355. Thirty seven (37) abstracts were removed due to duplication records, leaving 318 remaining to be screened, out of which, only 3 articles matched our inclusion and exclusion criteria and were thus included in this review. Meanwhile, meta analyses were not attempted due to heterogeneity of studies (Figure 1).

Using egg hatch assay against the ovine nematode *Haemonchus contortus*, study by [7] demonstrated weak ovicidal activity of fresh caprine milk *in vitro*, with only 9% and 4% inhibitions at the highest concentration of 100mg/ml and the lowest concentration of 6.25mg/ml, respectively. Besides, the work on caprine milk was only a part of a bigger sample utilizing other milks, such as cameline, ovine and bovine. The ovicidal assay, well designed and under proper controls, utilised 4 different ruminant milks. However, the conclusion made by the authors focused on the efficacy of cameline milk and not caprine milk (Table 1).

In another work by [8] using caprine milk kefir, the results demonstrated substantial dose-dependent ovicidal activity against *H. contortus in vitro*, with the highest inhibition of 88% and the lowest inhibition of 10% achieved at the concentrations of 0.25mg/ml and 0.03mg/ml, respectively, while no inhibition resulted at 0.015mg/ml. The ovicidal assay, well designed and under proper controls, utilised 4 different ruminant milks. In the same study, but using a different assay, caprine milk kefir demonstrated a 100% mortality rate against adult *H. contortus* by 8hrs incubation at 0.5mg/ml concentration while lowest concentration of 0.125mg/ml only resulted in 45.3% inhibition by 8 hrs. This mortality assay using adult *H. contortus* utilised 4 different ruminant milks and proper controls were adequate. However, a motility assay would have been a better tool to gauge anthelmintic efficacy [5]. Although the effect of caprine milk was substantial, it was not highlighted, because the authors focused only on the superiority of cameline milk (Table 1).

Other study also demonstrated the potent anthelmintic activity of caprine milk damaging worm cuticle and hypodermic ultrastructures [12]. This work utilised transmission electron micrographic study (viewing cross sections) which is usually the step taken after scanning electron micrography (viewing surfaces). Although proper controls were used, only the effect of caprine milk was studied. The usage of other milks, for example, that of bovine for comparison purposes, would have

made the study more comparative and conclusive. The authors equated their findings to cysteine proteinases based proteolytic effect [5] which is justified but may be premature (Table 1).

The search conducted resulted in a very limited number of articles (three). In previous studies, a screening for anthelmintic activity of milk in general [13] found only 8 related articles, while a screening for anthelmintic activity of date palm fruit [14] found only 2 articles. Anthelmintic efficacy studies are comparatively less in number, compared to antimicrobial studies, due to various factors, but it is obvious that, parasitic diseases are neglected. In 2016, the first study was conducted to test the efficacy of caprine milk, only found weak ovicidal activity using fresh milk [7]. In their finding, cameline milk appeared superior when compared to caprine, ovine and bovine milks. The anthelmintic efficacy of bovine milk has been proven in many works against the nematodes of humans, pigs, sheep, calves and rabbits [6] [15]-[18]. However, the anthelmintic mechanism remains at large with unsubstantiated propositions and only one study by [6] managed to determine the efficacy of different bovine milk components which led to the role of protein. Substantial dose-dependent caprine milk ovicidal and adulticidal activity against *H. contortus in vitro*, using caprine milk kefir have been demonstrated [8]. The relative efficacy of caprine milk kefir (fermented yoghurt like drink), compared to raw milk, may be attributable to its probiotic content, concentration of proteinaceous and fatty component during fermentation [6] [19]-[20]. An electron-micrographic study proved the potent anthelmintic activity of caprine milk against the canine hookworm *A. caninum* [12]. Their findings were comparable to fruit-derived cysteine proteinases mediated damage [5]. The limited findings of caprine milk anthelmintic activity should not be a hindrance for further research. Well-designed experiments for the development of natural products into useful medicine have been discussed with a series of developmental works being a good example of this (development of cysteine proteinases from fruits) [5] [14]. Nonetheless, caprine milk has the potential to be developed into functional food for parasitic worm control, especially in places where goat husbandry and consumption is popular. It is even more relevant due to the massive global disease burden resulting from helminth infection currently affecting more than a third of the developing world [2]

#### IV. CONCLUSION

Our review revealed limited anecdotal reports of anthelmintic effect of caprine milk against parasitic helminths. Further rigorous and more focused studies on caprine milk are needed to validate these anecdotal evidence.

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