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Short Communication

Detection of Clinical Anaemia Caused by *Haemonchus* spp. in Goats of Assam using an Eye Colour Chart: FAMACHA© Method

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ABSTRACT

The study was carried out to investigate the relationship amongst faecal egg count (FEC), FEC-Hc (*Haemonchus contortus*), packed cell volume and FAMACHA© score from 587 goats during the six study months (April – September, 2013). The three methods used for evaluating Haemonchosis i.e. FEC, packed cell volume, FAMACHA© score, were compared to test the FAMACHA© method for its accuracy and efficacy in detecting haemonchosis in Assam. In goats with egg per gram (EPG) level of 2050-2500, most of the goats fell in category 3 with pink eye colour, EPG level 3050-3500, most of the goats fell in category 4 with pink-white eye colour. Similarly, with EPG level 3550-4000, most of the goats fell in category 5 with white eye colour. Animals showed anaemic and severe anaemic conditions with the constant increase in the level of worm infection. It was also found that when the PCV level decreases the EPG increases and vice-versa. The faecal egg output of all GIN genera was high for this region throughout the study period. Based on the results of the larval culture, *H. contortus* was the predominant GIN species on all the study areas. FEC and FEC-Hc fluctuated over the study period with a maximum in the month of August (FEC = 3004.66 and FEC-Hc = 2000.00) and minimum in the month of September (FEC = 1519.23 and FEC-Hc = 1075.00). With the increasing of FAMACHA© score the PCV values decreases. This study revealed highly significant correlation between FEC and FAMACHA© eye scoring. In conclusion, FAMACHA© method was found to be a reasonably good indicator of clinical anaemia caused by *Haemonchus* spp. in Goats of Assam.

Key words: FAMACHA©, Anaemia, *Haemonchus contortus*, Goat, Assam, Targeted selection treatment

INTRODUCTION

In Assam, plain and hilly areas, farmed goats mostly have access to pasture and hence are frequently infected with gastrointestinal nematodes (GIN). However, a drug treatment alone cannot keep up with rapidly developing anthelmintic resistance (AR) in many areas. The escalation of AR in small ruminant husbandry calls for new methods for sustainable management of GIN infections. Among them, Targeted Selective Treatment (TST) using the FAMACHA© system has been proposed as an important alternation (Van Wyk *et al*., 2006). The FAMACHA© method is a diagnostic on farm system, which facilitates farmers to identify individual animals that need an anthelmintic treatment, through comparison of the colour of the ocular mucous membranes against a dedicated colour chart. The development and successful use of FAMACHA© method of clinical evaluation of anaemia associated with haemonchosis has facilitated the adoption of TST that is regarded as an alternate in ruminants (Leask *et al.,* 2013). This method is based on the anaemia-resulting, blood-sucking activity of *Haemonchus contortus*. The FAMACHA© categories range from 1- red (non-anaemic) to 5- practically white (severely anaemic) (Malan *et al*., 2001). Thereby, as suggested by Van Wyk and Bath (2002), only individual animals of the flock showing severe anaemia, i.e. goats with scored 3, 4 and 5, have to be treated selectively. By using this system for the application of TST, some animals almost always remain untreated. These animals continue to void ova that have not been exposed to anthelmintic selection onto pasture and these are said to be in refugia. As a consequence, the GIN population in refugia could be exploited to regain anthelmintic efficacy as discussed in theory by Van Wyk (2001). Although the FAMACHA© method is used and considered as a valuable

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tool in sub-Saharan Africa, Southern United States and South America, where *H. contortus* is very common (Mahieu *et al*., 2007), it is still largely unknown in Europe and Asia. Therefore, the question arised whether the FAMACHA© method is of use in India for the implementation of a more targeted anthelmintic dosing and for prevention of production losses in heavily infected flocks. So, therefore, the objective of this study was undertaken to evaluate the applicability of FAMACHA© method to detect the anaemia due to *Haemonchus* spp. in different goat flocks of Assam.

MATERIALS AND METHODS

The study was conducted for a period of six months from April to September 2013. A total of 587 goats randomly selected from organized farm, Goat Research Station, Assam Agricultural University, Burnihat and unorganized farms of different parts of Kamrup district of Assam. Each of the goats was subjected to periodic faecal egg count (FEC), packed cell volume (PVC), FAMACHA© score. At the beginning of each month, over the study period from April to September, 2013, the same individually tagged goats were sampled. The colour of the conjunctiva was clinically evaluated following the recommendations of the FAMACHA© method (Malan *et al*., 2001; Van Wyk and Bath, 2002). Simultaneously, faecal samples were directly taken from the rectum and 5 ml sterile EDTA-blood were collected from the jugular vein of each goat and transferred to the laboratory. The eggs were identified based on their morphology following the description of Soulsby (1982). The number of eggs per gram of faeces (EPG) of all the positive samples was determined by Stoll's method (HMSO, 1979). The infection for GIN level (FEC) was determined and the FEC of *H. contortus* (FEC-Hc) was estimated accordingly throughout the study period. The determination of PCV level was done as mentioned by Coffin (1995). Packed cell volume (PCV) was determined by using the micro-haematocrit method.

FMACHA© eye colour chart clearly depicts various categories from healthy to severely anaemic condition. The ocular mucous membranes of the goats were examined by comparing them with the laminated colour chart bearing the picture of goat conjunctiva (Kaplan *et al*., 2004). This chart was calibrated into five categories i.e. 1 = red (non-anaemic), 2 = red-pink (non-anaemic), 3 = pink (mildly-anaemic), 4 = pink-white (anaemic) and 5 = white (severely anaemic). FEC were performed using a modified McMaster's techniaque with a sensitivity of 50 eggs /g of faeces. All scorings were done on the same day along with faecal and blood samplings.

RESULTS AND DISCUSSION

From the present study the ranges of PCV and faecal egg counts (FEC) of GIN, were recorded in different FAMACHA© score presented in Table 1. These trends of the present study can be in comparable with Malan *et al*. (2001). Results revealed that in goats with eggs per gram (EPG) level of 2050-2500, most of the animals fell in category 3 with pink eye colour, EPG level 3050-3500, most of the animals fell in category 4 with pink-white eye colour. Similarly, with EPG level 3550-4000, most of the animals fell in category 5 with white eye colour (Table 2) showing severe anaemic condition. These trends of FEC, changes with FAMACHA© score can be comparable with Chaudhary *et al*. (2007). Animals showed anaemic and severe anaemic conditions with the constant increase in the level of worm infection. The results elucidated a relationship between EPG level and FAMACHA© categories.

Table 1: Range of PCV values for each FAMACHA© category as defined by Malan *et al.* (2001) and in comparison to those defined in the present study with the respective FEC-categories

FAMACHA© category	Clinical evaluation in preliminary Badplaas trial[a]	Initial ranges set by Malan *et al*. (2001)	PCV study	FEC study
1	Red	>28%	28-33	<900 epg
2	Red-pink	23-27%	23-27	500-2400 epg
3	Pink	18-22%	17-24	800-3400 epg
4	Pink-white	13-17%	11.5-19.5	1400-5200 epg
5	White	≤12%	8-12	3100-6100 epg

[a]Before the FAMACHA© concept had been initiated and refined.

Table 2: Various sets of FECs ranges in goats for evaluating FAMACHA© system

FAMACHA© categories	Faecal egg count (FECs) ranges											
	50-500	550-1000	1050-1500	1550-2000	2050-2500	2550-3000	3050-3500	3550-4000	4050-4500	4550-5000	5050-5500	5550-6000
1	15	17	0	0	0	0	0	0	0	0	0	0
2	4	59	9	0	0	0	0	0	0	0	0	0
3	0	16	16	45	63	31	15	0	0	0	0	0
4	0	0	0	13	25	36	60	48	14	2	0	0
5	0	0	0	0	0	5	10	34	19	15	8	8

Table 3: Mean faecal egg count (FEC) and packed cell volume (PCV) for each FAMACHA© scores

FAMACHA© score	No. of goat	Mean FEC/epg	Mean PCV %
1	32	575.00	29.46
2	72	906.94	24.87
3	186	1948.92	20.03
4	198	2959.09	14.66
5	99	4213.13	9.29

Table 4: Pattern of mean GIN and of *Haemonchus contortus* epg excretion during the six study months

Months	Overall mean FEC/EPG of GIN	Mean FEC/ EPG of *H. contortus*	FAMACHA© score along with their mean PCV value (%)				
			1	2	3	4	5
April	1419.30	1000.00	28.83	25.10	19.57	13.97	9.17
May	2014.06	1420.31	29.36	26.06	21.54	16.25	9.40
June	2433.96	1794.34	29.65	23.96	2016	14.79	9.33
July	2870.83	1900.00	28.90	24.79	20.21	17.61	9.40
August	3004.66	2000.00	30.79	26.19	20.36	17.24	9.22
September	1519.23	1075.00	28.50	21.71	19.98	15.07	9.00

Table 5: Percentage of goats in the various FAMACHA© categories during six study months

Months	No. of animals	Percentages of goat in the various FAMACHA© categories				
		1	2	3	4	5
April	57	6(10.53)	13(22.81)	22(38.60)	13(22.81)	3(5.26)
May	64	7(10.94)	8(12.5)	24(37.50)	20(31.25)	5(7.81)
June	53	4(7.55)	7(13.21)	18(33.96)	21(39.62)	3(5.66)
July	168	5(2.98)	17(10.12)	45(26.79)	61(36.31)	40(23.81)
August	193	7(3.63)	18(9.33)	56(29.02)	68(35.23)	44(22.80)
September	52	3(5.77)	9(17.31)	21(40.38)	15(28.58)	4(7.69)
Total	587	32(5.45)	72(12.27)	186(31.69)	198(33.73)	99(16.87)

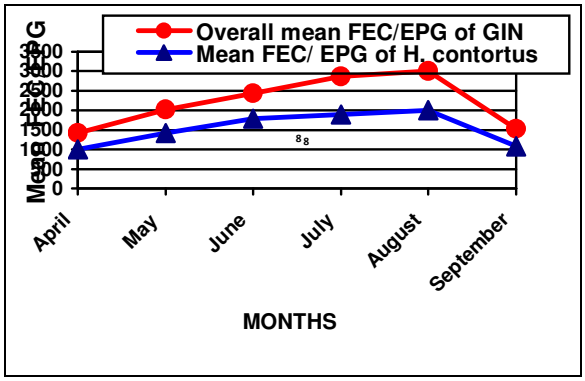

Fig. 1: Pattern of mean GIN and Haemonchus contortus epg excretion during the six study months

A total of 587 goats examined in the present study and found that when the PCV% level is high the EPG decreases and vice-versa. The mean EPG and PCV in FAMACHA© score 1 was (575.00 and 29.46%), in 2 (906.94 and 24.87%), in 3 (1948 .92 and 20.03%), in 4 (2959.09 and 14.66%) and lastly in 5 (4213.13 and 9.29%) (Table 3).

The faecal egg output of all GIN genera was high for this region throughout the study period. Based on the results of the larval cultures, *H. contortus* was the predominant GIN species on all the study areas. FEC and FEC-Hc (faecal egg counts – *Haemonchus contortus*) fluctuated over the study period with a maximum in the month of August (FEC = 3004.66 and FEC-Hc = 2000.00) and minimum in the month of September (FEC = 1519.23 and FEC-Hc = 1075.00). The high FECs are probably due to heavy contamination by animals in monsoon season which gives rise to a higher worm-burden in animals. Similar findings were made by Gupta *et al*. (1987). It was also observed that in all the six study months (April – September), with the increasing of FAMACHA© score the PCV values decreased accordingly (Table 4, Fig.1).

The percentage of goat in the various FAMACHA© categories during study period were highest in FAMACHA© score 4 (33.73%), followed by 3 (31.69%), then 5 (16.87%), 2 (12.27%) and 1 (5.45%) (Table 5).

The FAMACHA© system may be used to correctly mark those animals which require anthelmintic treatment and it is concluded that this system can prove to be a valuable tool for decision-making to control *H. contortus* in goats. This study revealed highly significant correlation between FEC and FAMACHA© eye scoring.

Further testing of the FAMACHA© clinical assay should also be pursued in goats as its application limits the spread of anthelmintic resistance and can also help to improve the genetic resistance.

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