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Use of FAMACHA to Detect Anaemia and Control of Gastrointestinal Parasite in Goats of A and N Islands, India

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ABSTRACT

Background: *FAffaMAlanCHArt* (FAMACHA) is a technique for treating the animals infested with gastrointestinal parasites by using clinical anaemia as the determinant. The test is based on the assessment of colour variation of the conjunctival mucous membrane.
Methods: In the present study FAMACHA has been standardized and used to correlate the anaemic status of goats with faecal egg count (gastro intestinal parasites) and blood profile. On the basis of FAMACHA score and faecal egg count, the goats were treated with benzimidazole compound and macrocyclic lactone.
Result: The result indicated significant (P<0.05) reduction in the faecal egg count of *Haemonchus* spp from 1200±155.76 to 525±75, *Strongyloides* spp from 469.57±77.37 to 78.26±33.83 and *Eimeria* spp from 900±240.05 to 195.65±55.34 respectively. FAMACHA score of anaemic goats improved from 4.08±0.11 to 3.2±0.13. Mean haemoglobin (g/dl), packed cell volume (PCV), red blood cell (RBC) and white blood cell (WBC) improved from 8.33 to 8.99, 22.66 to 24.86, 13.73 to 14.76 and 18029 to 19894, respectively which indicated clinical improvement. Highly significant (P<0.01) correlation was observed between the FAMACHA score and the haemoglobin level. It could be concluded that FAMACHA is a very handy tool to detect anaemic status of the animals and correlate with gastrointestinal parasitic load.

Key words: Blood profile, FAMACHA, Gastrointestinal parasites, Goat.

INTRODUCTION

The Andaman and Nicobar Islands are a group of more than 572 islands, islets, rocks *etc*. lies between 6° and 14 N° latitude and 92° and 94° E longitude. The island receives more than 3100 mm rain annually while the temperature varies between 18-35°C. The climatic condition of Andaman and Nicobar group of islands is hot and humid which favours the growth and proliferation of endoparasitic infestation in large and small ruminants (Sunder *et al*., 2019). Climate plays a very important role in proliferation and growth of gastrointestinal parasites (GIN). Report suggests that the gastrointestinal infestation usually reported from the tropical hot and humid countries (Gadahi *et al*., 2009; Domke *et al*., 2013). The climatic condition of the islands is also very conducive for proliferation of these parasites. Studies carried out in the islands showed very high (61.31%) prevalence of parasitic infection (CIARI, Annual Report 2018-19). Amongst the various parasitic cases the incidence of ascariasis, fascioliasis, strongyloides, amphistomiasis and haemonchosis are reported to be very common with number of cases per thousand animals ranged from 100 to 600 (Sunder *et al*., 2019). The infection of gastrointestinal parasites usually associated with low productivity in meat, milk, infertility problems, morbidity and in some cases mortality (Vanessa *et al*., 2014; Mohammed *et al*., 2016).

Worldwide, the most common gastrointestinal parasites reported are *Haemonchus contorus* and *Trichostrongylus* spp. in the small ruminants (Sani and Chandrawathani, 1996; Tan *et al*., 2014). Various reports are available which suggest the common prevalence of *H.contortus, Ostertagia* sp and *Trichostrongylus* spp. as the dominant parasites affecting small ruminants (Biu *et al*., 2012; Mohammed *et al*., 2016).

Generally, the policy of animal husbandry department of any state is to go for blanket deworming protocol to control the burden of parasitic infestation. However, it has been found that this trend has resulted in development of anthelmintic resistance (Chandrawathani, 2004; Domke *et al*., 2013).To overcome this problem, Dr. Faffa Malan evolved the technique for treating the animals infested with haemonchus by using clinical anaemia as the determinant. Subsequently, the name of the FAMACHA has been coined from the name of the Dr Faffa Malan (Bath *et al*., 1996; VanWyk *et al*., 1997). The test is based on the assessment of colour variation of the conjunctival mucous membrane of the animal. The

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standard chart colour varies from pink red (normal) to white (anaemic), for which scores are allotted as 5 (normal) to 1 (anaemic) (Malan *et al.*, 2001). Several studies have been conducted worldwide for the use of FAMACHA as diagnostic tool to correlate the anaemic status of the animals with the gastrointestinal worm load (Vatta *et al*., 2001; Kaplan *et al*. 2004; Burke *et al*., 2007; Loria *et al*., 2009; Mohammed *et al.,* 2016; Prasanth *et al*., 2020). In the present study, prevalence of gastrointestinal parasites in the semi-intensive management system of farmer's flock of South Andaman district was investigated. The egg per gram of faecal load was estimated and was correlated with FAMACHA score of the goat.

MATERIALS AND METHODS

Semi-intensive goat management and selection of animals

In Andaman and Nicobar Islands, goats are mainly reared under open range conditions (Semi-intensive management system) with provision of shelter during night. The majority of the goats are Andaman local goat, Teressa goat and admixture of Malabari crosses. Out of total livestock population of 154,733, goat constitutes 42% (65,324) (Sunder *et al*., 2019). The study was conducted in farmer's flock of three villages under Ferrragunj Tehsil of South Andaman district *viz*. Wandoor (N 11°36.05', E 92°37.19), Indiranagar (N 11°35.85', E 92°38.32') and Hasmatabad (N11°35.68', E 92°38.69'). The study was conducted from August to December 2020. A total of 67 animals were selected for the present study. The history of the animals were recorded and found that goats and cattle are usually let for open grazing together in the same pasture land.

Collection of faecal samples for egg count

Faecal samples were collected from all the animals by per rectal method and collected in sterile container. The faecal samples were kept in ice box and taken to laboratory for examination of egg count. Modified method of McMaster technique was used for determination of egg per gram (EPG) using saturated salt solution as flotation fluid to quantify the number of eggs (Joshua *et al.,* 2011, Rinaldia *et al*., 2011). On the basis of load of the parasitic eggs per gram of faecal content was categorised as mild infection (if count is less than 500), moderate infection (if count is ranges from 500 to 1500) and heavy infection (if count is more than 1500) (Chagas *et al*., 2008). The counting of the oocyst of coccidia was categorised as low (if the count is less than 1800), medium (if the count is between 1800 to 6000) and high (if the count is more than 6000) (Idris *et al*., 2012).

Collections of blood samples for haematology

Blood samples were collected from all the animals prior to deworming and 10 days post deworming. The blood (1 ml) was collected from jugular vein and mixed in EDTA coated vials and kept at 4°C. Haemoglobin concentration was measured by Sahli's acid haematin method (Sonia *et al*., 2012) and Haematocrit was estimated by micro-haematocrit method (Chowdhury *et al*., 2005). Total erythrocyte count (TEC) and total leucocyte count (TLC) were estimated by using Nambiar's diluting fluid (Bancroft and Marylin, 2008).

Assessment of anaemia by using FAMACHA score card

As per the standard procedure, FAMACHA was used to detect the colour of the conjunctival mucous membrane (Malan *et al.,* 2001). The score was recorded as: 1 (red, non-anaemic), 2 (red pink, non-anaemic), 3 (pink, mild anaemic), 4 (pink white, anaemic) 5 (white, severely anaemic). Based on the scoring obtained, the animals were further segregated and treated with benzimidazole anthelmintic. After 10 days of the anthelmintic treatment all the animals were checked for FAMACHA score and faecal samples were examined for eggs per gram (EPG) and oocyst per gram (OPG) of faeces and blood were collected to check the haematology parameters.

Statistical analysis

Data were expressed as mean ± S.E.M. Statistical reading and comparison among the group was performed by one way analysis of variance (ANOVA) by least significant differences (LSD) test with a p value ≤ 0.05 was considered significant (Snedecor and Cochran, 1994). One-way ANOVA was used to determine differences in all haematological indicators. Differences among groups were analysed for significance using Tukey's test.

RESULTS AND DISCUSSION

The prevalence of gastrointestinal parasites in the faecal sample was found to be 80.88%, of which, the prevalence of *Haemonchus* spp., was very high (91.3%) followed by *Eimeria* spp (78.26%) and *Strongyloides* spp. (72.7%) respectively. The EPG was found to be high for *Haemonchus* spp. (991.30±150.21), medium to low for *Strongyloides* spp. (469.56±77.37) and OPG was low for *Eimeria* spp. (900±240.1) respectively. Based on the severity of the infection, it was found that the animals were moderately infected due to *Haemonchus* sp and low infection was recorded for *Strongyloides* spp. and *Eimeria* spp. The result of the load of EPG post deworming was found to be decreased significantly in Haemonchus (525±75), Eimeria (195.65±55.33) and Strongyloides (78.26±33.83) (Fig 1).

A significant difference ($P<0.05$) was detected in the haemoglobin content, (g/dl) packed cell volume (%) and red blood cell (million/mm^3) of the animals before and after deworming treatment. However, there is no significant difference was observed for the white blood cell count (thousands/µl) (Table 1).

The result of the FAMACHA score of the animals prior to deworming treatment was 4.08±0.11. The value was significantly improved to 3.2±0.13 post deworming treatment. The correlation of the FAMACHA score with the haemoglobin content of the blood was significantly negatively correlated (r value = -0.89). The level of the haemoglobin increased with decrease in the FAMACHA score (Table 2).

In the present study, the prevalence of gastrointestinal parasites *viz*. *Haemonchus* spp., *Strongyloides* spp. and *Eimeria* spp. was found to be high. This could be due to the semi-intensive type of management system, wherein both cattle, goat and other livestock are allowed to graze together in the same pasture land (Gawor *et al*., 2006; Mohammed *et al*., 2016). The hot-humid and coastal climatic conditions of the islands further aggravates the proliferation of the gastrointestinal parasites (Sunder *et al*., 2019). However, the load of the egg/oocyst per gram of faecal content of the gastrointestinal parasites was low to medium. The findings of present study is in agreement with the occurrence of gastrointestinal parasites in India, Mynmar and other areas (Chikweto *et al.,* 2018; Sivajothi and Reddy, 2018; Win *et al*., 2020;. The prevalence of *Haemonchus* spp. was found to be very high (91.3%) followed by *Eimeria* spp. (78.26%) and *Strongyloides* spp. (72.7%) respectively. However, the severity of the infection in terms of eggs/oocyst per gram of faecal content was not in accordance with the frequency of the prevalence rate of gastrointestinal parasites. The load of *Eimeria* spp. was found to be low without any apparent clinical manifestation/symptoms. Similarly, the load of *Strongylodies* spp was also found to be low. However, the load of *Haemonchus* spp. was found to be moderately high. *Haemonchus* spp. is considered to be one of the most common GIN reported in small ruminants (Kaplan *et al*., 2004; Hassum, 2014; Sivajothi and Reddy, 2018). There are several reports available, in which the prevalence of GIN parasites varied from 50.51-86.05% from different parts of India (Pathak and Pal 2008; Tariq *et al*., 2010; Choubisa and Jaroli 2013; Gul and Tak, 2016; Dappawar *et al*., 2018; Verma *et al*. 2018) and similarly from other parts of the world (Ntonifor *et al*., 2013), Slovakia (95.9%) (Babjak *et al*., 2017), West Indies (98%) (Chikweto *et al*., 2018) and Iraq (91.5%) (Hassan and Barzinji 2018). The variation in occurrence of different percent prevalence of GIN parasites might be due to different agro-climatic situations prevailing in the different region and zones. Generally, the occurrence of most of the GIN parasites are subclinical in nature and rarely exhibit any clinical symptoms which is correlated with the age, health status, management condition and climatic condition. In the present study also, we have recorded the occurrence of medium to low level of GIN parasites infestation in goats without showing any clinical sign or symptoms. Generally, *Haemonchus* spp. are responsible for blood loss due to sucking of blood from the intestinal mucous of the animals which in turn responsible for anaemic status (Love and Hutchinson, 2003). In the present study also, prevalence of haemonchus was found to be high.

In the present study, the FAMACHA scores of the animals showed that very high percentage of animals (54.05%) were in the category of score 4, while 27.02% were in the category of score 5. Only 18.91% of the animals were found to be non-anaemic and falls under the category of FAMACHA score 3. The blood parameters analysis revealed that the Hb level in the animals with FAMACHA score of 3 was 10.08±0.07, score of 4 was 8.54±0.14 and score of 5 was 6.78±0.16 respectively. The result of the FAMACHA score is in line with the faecal egg count, wherein almost 90% of the animals were infested with GI parasites. Hassum *et al*. (2014) also reported low faecal egg count in the animals with FAMACHA score of 1 and 2. Highly significant (P<0.01) correlation was observed between the FAMACHA score and the haemoglobin level with r value of 0.89. This shows that

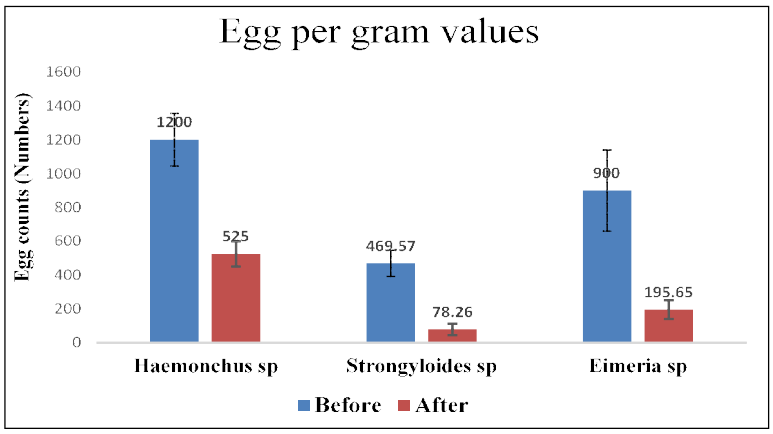

Fig 1: Prevalence of gastrointestinal parasitic infection (EPG) before and after deworming. ** p≤0.01, *** p≤0.001

Table 1: Haematology parameters before and after deworming.

Parameters	Before deworming (Mean ± SE)	After deworming (Mean ± SE)	P - Value	Result
Haemoglobin (g/dl)	8.32±0.22	9.03±0.12	0.0048	**
PCV%	22.71±0.66	24.95±0.70	0.0237	*
RBC (millions/mm3)	13.84±0.45	14.99±0.33	0.0400	*
WBC (NS) (Thousands/µl)	17937.0±1180.9	19392.5±1069	0.3631	NS

**Highly significant P≤0.01, *Significant P≤0.05.

Table 2: Correlation of FAMACHA with Hb level.

Parameters	Before deworming	After deworming	r value
FAMACHA Score	4.08±0.11	3.2±0.13	- 0.8967
Hb level	8.45±0.20	9.03±0.12	

the Hb level decreases, if the FAMACHA score increases which in turn reflects the anaemic status of the animals. The presence of high load of GIN parasites are responsible for poor health status of the animals and thereby decreases the Hb level. The average PCV level of the animals were found to be 22.71±0.66, which is considered to be low. The Hb and PCV level are directly related with the health status of the animals. If the animals are infected with high parasitic load and there is loss of blood due to intestinal parasites, the value of Hb and PCV decrease. In the present study, there is highly significant correlation was found between FAMACHA score and the Hb content.

Kaplan *et al*., 2004 and Malan *et al*., 2001 showed positive correlation with the FAMACHA score and faecal egg count. In the present study, we also found decrease in the level of faecal egg count with FAMACHA score and Hb value. The high level of faecal egg count during this study period might be due to the high load of parasites in the pastures. Reports also suggested that parasitic cases are more observed during this period in this region (Sunder *et al*., 2019).

All the animals treated with benzimidazole anthelmintic showed significant response and reduction in the faecal egg count, improvement in the FAMACHA score, Hb level, PCV level and RBC count. The result of the post deworming egg count and blood parameters showed that FAMACHA is very important tool in the field to correlate the anaemic status of the animals with the GIN parasitic load. The use of this tool is very simple and can easily be transferred to the farmer's field as gold standard test for rapid detection and accurate treatment of the animals. In the present study 81% of the animals were found to be anaemic with FAMACHA score of 4 and 5. All of these animals were treated with anthelmintic. The result of the post deworming showed significant reduction in faecal egg count and improvement in FAMACHA score. Several reports are available worldwide, wherein the use of FAMACHA has been successfully described in the small ruminants (Van Wyk *et al*., 1997; Chaudary *et al*., 2007; Burke *et al*., 2007; Mohammed *et al*., 2016; Mohammedsalih *et al*., 2019; Hassum *et al*., 2020). Vilela *et al.* (2008) also reported that despite of the moderately high load of faecal egg count (1300), the animals had no signs of illness. Burke *et al.,* 2007 reported significant correlation between FAMACHA score and the faecal egg count.

Initially, the FAMACHA score card was developed with the idea to identify individual animals which requires anthelmintic treatment thereby to reduce the anthelmintic resistance problems. Later on this technique has been globally accepted and has been used in the flock to detect the health status of the animals and devising strategy for the anthelmintic treatment. The use of the FAMACHA has also been recommended for routine health check-up of the animals at regular interval (Mahieu *et al.,* 2007; Riley and Van, 2009).In the recent years, the development of anthelmintic resistance due to the non-judicious practice of drenching has been evolved as the serious concern worldwide (Chanrawathani, 2004; Domke *et al*., 2013). Generally, it has been seen that in most of the cases, the animals are showing subclinical symptoms of the GI parasitic infestation. This might be due to the fact that the load of the parasites is below the threshold level or the parasites are developed fully/partial resistant to anthelmintic (Tan *et al*., 2014). In the present study also, similar type of observation were reported. Overall, health status of the animals were found to be below normal, with low FAMACHA score, low Hb level and other blood parameters. However, the animals did not exhibit any clinical symptoms. Similar type of observation were also reported by Abott *et al*., 1986 and Mavrot *et al*., 2015. Usually, the management and treatment of gastrointestinal parasites is by drenching heavy load of anthelmintic which has led to the development of anthelmintic resistance worldwide (Mortensen *et al*., 2003; Kaplan *et al*., 2004). Vanessa *et al*. (2014) showed that with effective use of FAMACHA for treatment of GIN parasites could reduce the cost of the medication by 75.6%. Therefore the use of FAMACHA with effective and specific treatment of GIN parasites will certainly help in reducing the cost of unwarranted expenditure on the deworming and thereby help in reducing the burden of anthelmintic resistance.

The climatic condition of the place and region plays an important role in proliferation of the GIN parasites. The climate of A and N islands is hot and humid, thus the prevalence of parasitic infestation is very high (Sunder *et al*., 2019). Study with similar climatic conditions also reported the high prevalence of GIN parasites (Gadahi *et al*., 2009; Domke *et al*., 2013; Mohammed *et al*., 2016). In addition to the climatic condition the management of the animals also plays an important role in the prevalence of parasitic cases. In this island the animals are generally allowed for open grazing in the pasture with other livestock and there is high possibility of transmission of parasites through faecal material between the different livestock.

CONCLUSION

Based on the result of the present study, it could be concluded that FAMACHA is a very handy tool to detect anaemic status of the animals in the field. Thereby the cost of unnecessary anthelmintic could be avoided and the anthelmintic resistance could be prevented. The other advantage of the FAMACHA is that it can effectively be used for diagnostic purpose, if the same animal is being infected with frequent parasitic load. This could save money in unwarranted treatment and will be used to cull the animal if the same animal is being consistently infected. The study also established highly significant correlation between the FAMACHA score and Hb level. The present study successfully examined and detected the animal's suffering

from anaemia due to GIN parasites and subsequent treatment with anthelmintic cured the animals from anaemia and GIN parasitic load. The FAMACHA tool is very handy and can easily be used by any layman or farmer. It is recommended that the FAMACHA score card should be propagated in the farmer's field for its effective use and correct diagnosis and treatment of the animals to avoid the risk of anthelmintic resistance.

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