Research Journal of
Veterinary
Sciences

aj
Academic
Journals Inc.

Validation of the FAMACHA© Eye Color Technique for Detecting Anemic Sheep and Goats in Jigjiga Zone of Somali Region, Eastern Ethiopia

[1,2]B. Adehanom, [2]D. Dagnachew, [3]Teshale Teklue and [2]N. Surendra
[1]Alamata Agricultural Research Center, P.O. Box 56, Alamata, Ethiopia
[2]College of Veterinary Medicine, Jigjiga University, P.O. Box 1020, Jigjiga, Ethiopia
[3]Mekelle Agricultural Research Center, P.O. Box 258, Mekelle, Ethiopia

*Corresponding Author: B. Adehanom, Alamata Agricultural Research Center, P.O. Box 56, Alamata, Ethiopia
Tel: +251-347740546, +251-914159728*

ABSTRACT

Faffa Malan Chart (FAMACHA©) is a practical on-farm system designed as selective deworming tool for *Haemonchus contortus* infection control. While system is becoming very popular it is not adopted in Ethiopia. Thus, the objective of this study was to validate FAMACHA© in detecting clinical anemia in sheep and goats at field level. The study was conducted in Jigjiga zone of Somali Regional State, Ethiopia from December 2011 to April 2012 on sheep (n = 192) and goats (n = 192) of various age and sex. Highly significant correlation between eye color and fecal egg count (p = 0.001) for goats and sheep (p = 0.043) was observed. There was also highly significant association between eye color and Packed Cell Volume (PCV) in sheep (p = 0.00) and goats (p = 0.005). The sensitivity of FAMACHA in detecting anemic animals was 66% for sheep and 71.43% for goats using eye scores 4 and 5 were considered as anemic at PCV <24% for sheep and <20% for goats. The present study indicated that the application of FAMACHA system for treatment protocol was promising both in goats and sheep. Therefore, the technique should be introduced as integrated diagnostic tool at field level in Ethiopia.

Key words: Anemia, FAMACHA eye score, *Heamonchus contortus*, goat, sheep, Somali Region, Ethiopia

INTRODUCTION

Ethiopia possesses huge livestock population in which small ruminants maintain significant number. The current sheep and goat population is 25,489,204 and 24,060,792, respectively (CSA., 2013). The total annual meat production comes from cattle (63%), sheep (25%) and goats (12%). At the national level, they account for about 90% of the live animal/meat and 92% of skin and hide according to FAO (2004) and Gizaw *et al.* (2010). Export trade value is far below the huge potential due to biological and other constraints. Livestock disease is among the most devastating biological agents affecting the goat production. The most important diseases of sheep and goats in Ethiopia are Peste des Petits Ruminants (PPR) and contagious caprine pleuropneumonia, sheep and goat pox and gastro intestinal parasites (ESGPIP., 2009).

Gastrointestinal nematodes; *Haemonchus contortus*, *Trichostrongylus* spp., *Oesophagostomum* spp., *Bunostomum* spp., *Strongyloides* spp., *Trichuris ovis* and *Chabertia* spp. (Sissay *et al.*, 2007) are among the biological constraints in Ethiopia affecting sheep and goats production. However, for the pastoralists drugs are relatively expensive and are often not accessible

(Sissay *et al*., 2007) but a selective approach that targets the portion of the herd or flock with high worm burdens is an opportunity for successfully control parasites in the entire group while reducing drug costs and delaying the development of anthelmintic resistance (Barger, 1985).

The FAMACHA system was highly advantageous which easily cop up by farmers which have significance value in reduction in treatment costs. Knowing the infection level among flocks creates reproduction more friendly to the natural environment and reduces the occurrence of anthelminthic resistance (Van Wyk and Bath, 2002).

FAMACHA a novel system that has been developed in South Africa for clinical identification of anemic sheep and goats (Bath *et al*., 1996) supports selective treatment approach. In this method, the color of the ocular mucus membrane of each animal can be examined and classified into five categories by comparison with laminated FAMACHA eye color chart. FAMACHA system works best under poor farmers where *Haemonchus contortus* reaches lethal level more quickly. The application method used as guidance for the administration of anthelminthic drugs could be valuable tool. Many farmers treat their animals against gastro intestinal parasites without using feacal laboratory analysis, in which the treatment efficacy with consequent danger worm resistance arises. So that using FAMACHA method prevents from infection and mortality loss (Scheuerle *et al*., 2010). In field work where fast diagnosis is needed and laboratory service scarce countries like Ethiopia the FAMACH technique is advantageous. Therefore, this study has been conducted to validate the FAMACHA eye color chart sensitivity in detecting clinical anemia in sheep and goats that are affected by *Haemonchus contortus.*

MATERIAL AND METHODS

Study area description: The study was carried out at three predominant pastoral and agro-pastoral districts of Jijiga administrative zone. The zone is located 9°21'-9.35° North latitude and 42°48'-42.8° East longitude in the Northern part of Somali regional state of Ethiopia. It covers a total land area of 40.86 km^2 with altitude ranging from 500-1650 m above sea level and is characterized by a semi-arid climate with an average daily temperature of 20-35°C. Overall, the zone experiences a low bimodal rainfall pattern of high variability-short rains or "deyr" (October to November) and long rains or "gu" (March to April) -with an annual mean of 600-700 mm. Livestock herding is a prevalent farming activity of the rural population with free range pastoralist and agro-pastoralist management dominantly (Eshetu *et al*., 2013). Somali region possessed 1,281,998 of sheep and goats, from which about 972,528 sheep and 747,685 goats represented that of Jigjiga Zone (CSA., 2013).

Study design and sample size determination: A cross sectional study design was followed according to Dohoo *et al*. (2003) from December, 2011 to April 2012. Sheep and goats of both sex and various age groups were included in the study. The following formula was used to calculate the sample size at 95% confidence interval 0.05 desired absolute precision and 50% expected prevalence to make the sample size maximum (Thrusfield, 2005):

$$n = \frac{1.96^2 \ Pex \ (1- Pex)}{d^2}$$

where, n is required sample size, P_{exp} is expected prevalence and d is desired absolute precision. Accordingly a total of 384 sheep and goats (192 each) were sampled from Jigjiga Zone of Somali Region.

Field examinations and sampling procedures: General clinical examination and FAMACHA eye color score estimation has been performed for each animal. Blood sample (about 2 mL) from jugular vein was collected from each animal using a vacutainer containing sodium heparin as anticoagulant. All the blood samples were brought to Jigjiga Regional parasitology laboratory for Packed Cell Volume (PCV) determination and for estimation of anemia. The FAMACHA eye color scores values 3, 4 and 5 or 4 and 5 were considered anemic while 1 and 2 or 1, 2 and 3 were considered as non-anemic.

Fecal samples from each animal were also collected for Fecal Egg Count (FEC). Feces were collected directly from the rectum of small ruminants and taken into well screwed universal bottle and then immediately taken to the regional parasitology laboratory for examination. Around 10 g of feces was collected immediately after stimulating defecation. When immediate examinations of fecal samples were not possible, fecal samples were preserved with 10% formalin (Hansen and Perry, 1994).

Laboratory investigations: Packed Cell Volume (PCV) level was determined using standard methods, PCV less than 20% for goats and less than 24% for sheep was considered as anemic, as described by Chaun and Agarwal (2008). Fecal egg count was carried out using the standard method of McMaster egg count procedure by Zajac and Conboy (2006). The fecal egg count for the strongyles egg has been recorded as severe infection, moderate infection and mild infection according to Farhana (2006). A true positive result was defined as animals that are anemic PCV value <20% for goats, <24% for sheep with pale eye scores (4, 5 or 3, 4, 5). False positive results were defined as animals that are not anemic PCV ≥20% for goats, ≥24% for sheep. False negative results were defined as animals that are anemic with red or pink eye scores (1, 2, or 1, 2, 3). True negative results were defined as animals that are not anemic with pink or red eye scores according to Vatta *et al.* (2001).

Data analysis: The data obtained for FAMACHA eye color scores, PCV and fecal egg count has been analyzed by using SPSS version 17. The Spearman correlations of cross tabulation has been calculated for each species to examine the relation between the FAMACHA eye color score and PCV, FAMACHA eye color scores and fecal egg count in pair, respectively.

RESULTS

Distribution of eye color, PCV and FEC in sheep and goats ruminants: The prevalence of strongly parasites in sheep and goats, using the technique of fecal egg count was 149 (77.6%) and 110 (57.3%) in sheep and goat, respectively. By considering the FAMACHA eye score four and five as anemic, there were 27 (14.1%) and 14 (7.3%) of anemic goats and sheep, respectively. The prevalence of anemia using the values of PCV (<20% for goats, <24% for sheep) was 16 (8.3%) goats and 32 (16%) sheep which are anemic was indicated in Table 1. In the present study animals have been said to be anemic with eye color score of 3, 4 and 5 with PCV <20% for goats, <24% for sheep (Table 1).

Association of eye color score with PCV and FEC: There was a significant association between eye color score and PCV, eye color score and fecal egg count using two sided Pearson's chi-square test cross tabulation (p = 0.001) in both in sheep and goat, their χ^2 value is outlined in the Table 2.

Prevalence of false positive, true negative, false negative and true positive in sheep and goats: Eye score values were compared with PCV to determine the false negative and false positive animals. False negative animals are animals that were anemic with eye color score red and red pink eyes (1, 2) with PCV value less than 24% for sheep and less than 20% for goats without considering the eye color score 3 (border line). A true negative result was defined as animals that were not anemic with pink or red eye scores. False positives are animals that were not anemic (PCV >24% for sheep, PCV >20% for goats) with pale eye score (4 and 5) and true positives are animals that were anemic (PCV <20% for goat, PCV <24% for sheep) with pale eye color score (4 and 5) without considering the eye color score 3 (borderline). Using the category for need of treatment (PCV<24% for sheep, <20% for goats and eye color score ≥4) for sheep and goats, less than 3 and 1.1% of sheep and goats, respectively have failed to receive the required treatment false negatives as shown in Table 3.

Table 1: Distribution of eye color, PCV and FEC in sheep and goats examined in Jigjiga Zone, Eastern Ethiopia

Variables	Goats		Sheep	
	Frequency	Percentage	Frequency	Percentage
Eye color				
1	9	4.7	45	23.4
2	65	33.9	78	40.6
3	91	47.4	55	28.6
4	19	9.9	10	5.2
5	8	4.2	4	2.1
PCV (%)				
Minimum value	16	8.3	32	16.7
Normal value	78	40.6	138	71.9
Maximum	98	51	22	11.5
FEC (epg)				
0 (no infection)	82	42.7	43	22.4
50-500 (mild infection)	52	27.1	110	57.3
500-1000 (moderate) infection	54	28.1	39	20.3
>1000 (severe infection)	4	2.1	-	-

PCV: Packed cell volume, FEC: Fecal egg count

Table 2: Association of eye color score with PCV and FEC using two sided Pearson's chi- square test cross tabulation

	Eye color			
	Goats		Sheep	
Variables	χ^2	p value	χ^2	p value
PCV	66.906	0.001	21.893	0.005
FEC	34.286	0.001	57.299	0.001

PCV: Packed cell volume, FEC: Fecal egg count

Table 3: Prevalence of false negatives, true negative, false positive and true positive animals

Variables	Values
Goats (PCV)	
False negatives	2 (1.04%)
False positive	45 (23.43%)
True negatives	72 (37.5%)
True positives	5 (2.6%)
Sheep (PCV)	
False negatives	5 (2.6%)
False positives	4 (2.08%)
True negatives	118 (61.45%)
True positives	10 (5.2%)

PCV: Packed cell volume

Table 4: Sensitivity and specificity FAMACHA in sheep and goats using PCV as a comparative test

Result (%)	Goats	Sheep
Sensitivity	71.43	66.66
Specificity	61.53	96.70
PVneg	97.30	95.90
PVpos	55.55	71.4

PCV: Packed cell volume, Sensitivity: [true positives/ (true positives+false negatives)]×100, Specificity: [true negatives/ (true negatives+false positives)]×100, Predictive value of a negative (PVneg: [true negatives/ (true negatives+false negatives)]×100, Predictive value of a positive, (PVpos): [true positives/ (true positives+false positives)]×100

Sensitivity and specificity FAMACHA in sheep and goats: In this study, the sensitivity and specificity of FAMACHA tests has been done for both species of animals. Accordingly the sensitivity for goats compared to the PCV value of less than 20% was 71.43%, the specificity using PCV cutoff value was 61.53% for goats. The sensitivity for sheep also using PCV less than 20 values was 66.66% and the specificity using PCV was 96.7% as shown in Table 4.

DISCUSSION

In evaluating the ability of FAMACHA$^©$ to correctly identify anemic animals in need of treatment, the cut off for PCV used for declaring anemia will have a great impact on the results. Therefore, the cutoff values of PCV <20% for goats, PCV<24% for sheep were considered to be anemic according to Chaun and Agarwal (2008). In the current study, correlations between eye color score and fecal egg count in goat is significant (p <0.05) in both sheep and goats. This result agrees with the findings of Kaplan *et al*. (2004) and Burke *et al*. (2007), but significant level was lesser in the present study this may be due to manual error during categorization of eye color score of animals. Correlations were negative between eye color and PCV, this result agrees with the finding of Kaplan *et al*. (2004).

Taking eye scores 4 and 5 as criteria for treatment, the sensitivity decreases noticeably in sheep than in goats but there is a concurrent increase in specificity in sheep than goats. The number of false negatives increases in sheep than in goats, by using the PCV cutoff value, with a 2.6 and 1.04% for sheep and goats, respectively. However, this result contradicts with the finding of Kaplan *et al*. (2004), which is higher in goats than in sheep. This indicates that the application of FAMACHA system for the treatment regimen is more appropriate in goats than sheep. Considering eye scores 4 and 5 as anemic, sensitivity of FAMACHA system comparing to PCV was found to be lower and specificity was higher in sheep. This agrees with previous studies by Burke *et al*. (2007). High sensitivity is much more important since not treating a false negative means that an animal will endanger of dying, whereas no harm will be imposed by treating false positive ones. In agreement with results of Vatta *et al*. (2001), Van Wyk and Bath (2002) and Kaplan *et al*. (2004). The sensitivity and specificity of the current study for goats were 71.43 and 61.53%, respectively, this contradicts with finding of Scheuerle *et al*. (2010), which is 50 and 80.4% but this due to sample size difference but the average nearly similar which is 66.9 and 65.2%, respectively and also the predictive value of negative was nearly similar which was 97.3 and 99.7% which indicts the test accurate. This study revealed that a lower sensitivity in sheep using PCV as a parameter and this is due to the increase in number of false negative animals. The specificity and sensitivity in goats ranges (61-71%) relatively similar with the finding by Vatta *et al*. (1999), in which the specificity and sensitivity ranges (67-69%) for identifying goats requiring treatment when animal category 3, 4, 5 are considered anemic (Van Wyk and Bath, 2002).

CONCLUSION

The evaluation of FAMACHA© eye color score technique in relation to the hematological parameter PCV and fecal egg count in sheep and goats indicated that FAMACHA system is a valuable and practical tool that experts can use to identify animals in need of treatment, to reduce the number of animals to be treated, thereby saving money. Using the FAMACHA system animals that repeatedly require treatment can also be identified and culled to reduce the herd/flock worm load. The FAMACHA technique will have a valuable contribution to the implementation of integrated program for control of gastrointestinal heamoparasites.

ACKNOWLEDGMENTS

REFERENCES

Barger, I.A., 1985. The statistical distribution of trichostrongylid nematodes in grazing lambs. Int. J. Parasitol., 15: 645-649.

Bath, G.F., Malan, F.S. and J.A. VanWyk, 1996. The FAMACHA© ovine anemia guide to assist with the control of haemonchosis. Proceedings of the 7th Annual Congress of the Livestock Health and Production Group of the South African Veterinary Association, June 5-7, 1996, Port Elizabeth, South Africa, pp: 5.

Burke, J.M., R.M. Kaplan, J.E. Miller, T.H. Terrill and W.R. Getz *et al.*, 2007. Accuracy of the FAMACHA system for on-farm use by sheep and goat producers in the Southeastern United States. Vet. Parasitol., 147: 89-95.

CSA., 2013. Agricultural sample survey 2012/13 [2005 E.C.] Volume II: Report on livestock and livestock characteristics livestock and livestock characteristics (private peasant holdings). Statistical Bulletin No. 570, Central Statistical Agency (CSA), Addis Ababa, Ethiopia, April 2013.

Chaun, R.S. and D.K. Agarwal, 2008. Veterinary Clinical and Laboratory Diagnosis. 2nd Edn., Jaypee Brothers, Medical Publishers Ltd., New Delhi, India, ISBN-13: 9788180615726.

Dohoo, I.R., W. Martin and H. Stryhn, 2003. Veterinary Epidemiologic Research. 2nd Edn., VER, Incorporated, Charlottetown, Canada, ISBN-13: 9780919013605, pp: 85-120.

ESGPIP., 2009. Ethiopian sheep and goat improvement program technical manual. Ethiopia Sheep and Goat Productivity Improvement Program (ESGPIP), Addis Abeba, Ethiopia.

Eshetu, Z., B. Desta and L.B. Amare, 2013. Prevalence of *Trypanosoma evansi* Infection in the one-humped camel (*Camelus dromedarius*) in Jijiga administrative zone of the Ethiopian Somali region. Global Veterinaria, 10: 233-238.

FAO., 2004. Livestock sector brief: Ethiopia. Livestock Information, Sector Analysis and Policy Branch (AGAL), FAO, Rome, Italy. http://www.fao.org/ ag/ againfo/ resources/ en/ publications/ sector_briefs/lsb_ETH.pdf.

Farhana, R.C., 2006. Study on the biology of Heamonchus contortus, in small ruminants grazing in Potohar region, Pakistan. Ph.D. Thesis, Department of Zoology Faculty of Sciences University of Arid Agriculture, Rawalpindi, Pakistan.

Gizaw, S., A. Tegegne, B. Gebremedhin and D. Hoekstra, 2010. Sheep and goat production and marketing systems in Ethiopia: Characteristics and strategies for improvement. Improving Productivity and Market Success (IPMS) of Ethiopian Farmers Project Working Paper No. 23, International Livestock Research Institute (ILRI), Nairobi, Kenya, pp: 1-58.

Hansen, J. and B. Perry, 1994. The Epidemiology, Diagnosis and Control of Helminth Parasites of Ruminants: A Hand Book. Food and Agricultural Organization of UN, Rome, Italy, pp: 72-89.

Kaplan, R.M., J.M. Burke, T.H. Terrill, J.E. Miller and W.R. Getz *et al.*, 2004. Validation of the FAMACHA© eye color chart for detecting clinical anemia in sheep and goats on farms in the Southern United States. Vet. Parasitol., 23: 105-120.

Scheuerle, M., M. Mahling, J. Muntwyler and K. Pfister, 2010. The accuracy of the FAMACHA©-method in detecting anaemia and haemonchosis in goat flocks in Switzerland under field conditions. Vet. Parasitol., 170: 71-77.

Sissay, M.M., A. Uggla and P.J. Waller, 2007. Prevalence and seasonal incidence of nematode parasites and fluke infections of sheep and goats in Eastern Ethiopia. Trop Anim. Health Prod., 39: 521-531.

Thrusfield, M., 2005. Survey in Veterinary Epidemiology. 2nd Edn., Blackwell Science Ltd., Oxford, UK., pp: 178-198.

Van Wyk, J.A. and G.F. Bath, 2002. The FAMACHA© system for managing haemonchosis in sheep and goats by clinically identifying individual animals for treatment. Vet. Res., 33: 509-529.

Vatta, A.F., R.C. Krecek, J.A. van Wyk, G.F. Bath, B.A. Letty, M.J. van der Linde and H.T. Groeneveld, 1999. Testing a novel technique for the resource-poor farmer to manage *Haemonchus* spp. in South African goats. Enhanced Research Capacity (ENRECA) Workshop, Kenya, August 1999.

Vatta, A.F., B.A. Letty, M.J. van der Linde, E.F. van Wijk, J.W. Hansen and R.C. Krecek, 2001. Testing for clinical anaemia caused by *Haemonchus* spp. in goats farmed under resource-poor conditions in South Africa using an eye colour chart developed for sheep. Vet. Parasitol., 99: 1-14.

Zajac, A.M. and G.A. Conboy, 2006. Veterinary Clinical Parasitology. 7th Edn., Blackwell Publishing, UK., ISBN-13: 978-0813817347, Pages: 320.