# FECAL EGG COUNTS: USES AND LIMITATIONS

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**Abstract:**

The microscopic examination of feces for the assessment of gastrointestinal parasite infection has been a mainstay of clinical and research parasitology labs for many decades. Even with the widespread use of fecal egg counts (FECs) in the medical and scientific community, the routine use of FECs by farmers and producers is quite limited in most areas of the world. The lack of use of this very valuable tool is most probably due to a lack of consistent and understandable information regarding the simplicity and value of the FEC. Some of theinformation that one can obtain via the internet concerningFECs is of variable quality and clarity.Accurate information and training can help to correct the misunderstandings concerning the limitations of the FEC as well as expand its acceptance and use. The modified McMaster FEC technique, which is one of the most widely used quantitative FEC methods in practice today, simple to perform and when used as an adjunct to body condition score, FAMACHA score, geographical location, and fecal consistency scoring (e.g. The Five Point Check) can provide a wealth of information to the farmer/producer. The quantitative FEC not only provides the trained user with information regarding the types parasites present in the sample (trichostrongyles, tapeworm, whipworm, coccidia, lungworm, etc.) as well as an estimate of the quantity of parasite eggs being shed in the feces (eggs per gram) for monitoring pasture contamination. The FEC is also invaluable in the monitoring of anthelmintic (drench/dewormer) effectiveness in controlling these parasites in the flock/herd. The McMaster FEC, when performed with reasonable care and consistency, provides the user invaluable information pertaining to parasite control and management, which can lead to improved herd health and increased production.

**Introduction and historical perspective:**

The microscopic examination of feces for the detection ofgastrointestinal parasite eggs as an indicator of parasite infection is one the most widely used tools in classical clinical parasitology as well as parasitology research labs. The FEC has also gained popularity as a valuable tool among producers and producer groups. A search of the published scientific literature shows that there have been more than 6000 scientific papers (all species and disciplines) published using data from fecal egg counts since the appearance of the first publication on the subject in 1923.The 1923 article was entitled “Investigations on the control of hookworm disease. XV. An effective method of counting hookworm eggs in feces” and was authored by Dr. Norman Stoll(Stoll, 1923) .Stoll developed a quantitative method for hookworm eggs (in humans)while working at the School of Hygiene and Health at John’s Hopkins University. The procedure,"Stoll dilution egg-counting technique",created by Stoll was adopted around the world for major epidemiological studies of hookworms. This significant contribution also providedthe genesis from whichcurrent fecal egg count procedures and techniques evolved(Ashton, 1977). Stoll would follow his human hookworm work with additional publications, but his publication in 1930, “On Methods of Counting Nematode Ova in Sheep Dung” helped to launch the quantitative fecal egg count into the arena of veterinary medicine(Stoll, 1930). Many others have built upon Stoll’s technique over the years, with one of the most significant occurring in 1939, where H.V. Whitlockwas serving as a laboratory assistant for the McMaster Animal Health Laboratory in Sydney Australia. Whitlock, in the course of his duties, performed hundreds of fecal egg counts every day, using the method described by Stoll in his 1930 paper and sought a way to improve his lab efficiency. Whitlock developed a special slide that incorporated Stoll’s precise sampling with a flotation technique(Whitlock and Gordon, 1939). The resulting “McMaster Counting Chamber”along with the modifications Whitlock would later make (Whitlock, 1948), are the basis for the many Modified McMaster fecal egg count slides and procedural variants widely used today.

**What is a Fecal Egg Count?**

History aside, what exactly are fecal egg counts? (Note-depending on the country/locale that you are in,a fecal egg count may be referred to asa“fecal”, “FEC”,“epg”, “worm eggcount”, “WEC”, “fecal worm egg count”, “worm test” or just “egg count” – ergo“A rose by any other name would smell as sweet”?). A FEC is a procedure performed on a manure sample to detect the presence of parasitic worm eggs. There are two classes of FEC, one being qualitative, meaning that the results are reported as “positive” or “negative” and are generally based on a basic fecal floatation procedure. Qualitative FECs can also be reported with a minus sign ( - ) for

negative (no eggs seen) or positive as “+, ++, +++”, with the number of plus signs signifying the subjective opinion of the technician as to the number of eggs present.The qualitative FEC is generally performed by mixing a small amount of feces with a floatation solution in a small vial.  The solution level is increased to the point where a small positive meniscus is formed and then a microscope slide cover slip is then placed on top. This is allowed to sit for 10 to 30 minutes depending on the protocol that is being followed, after which time the cover slip is carefully lifted from the vial and placed on a microscope slide for examination with a microscope The entire coverslip is examinedfor the presence of parasitic worm eggs under a magnification of 100x (typically)(Hansen and Perry, 1994) (Figure 1).  .

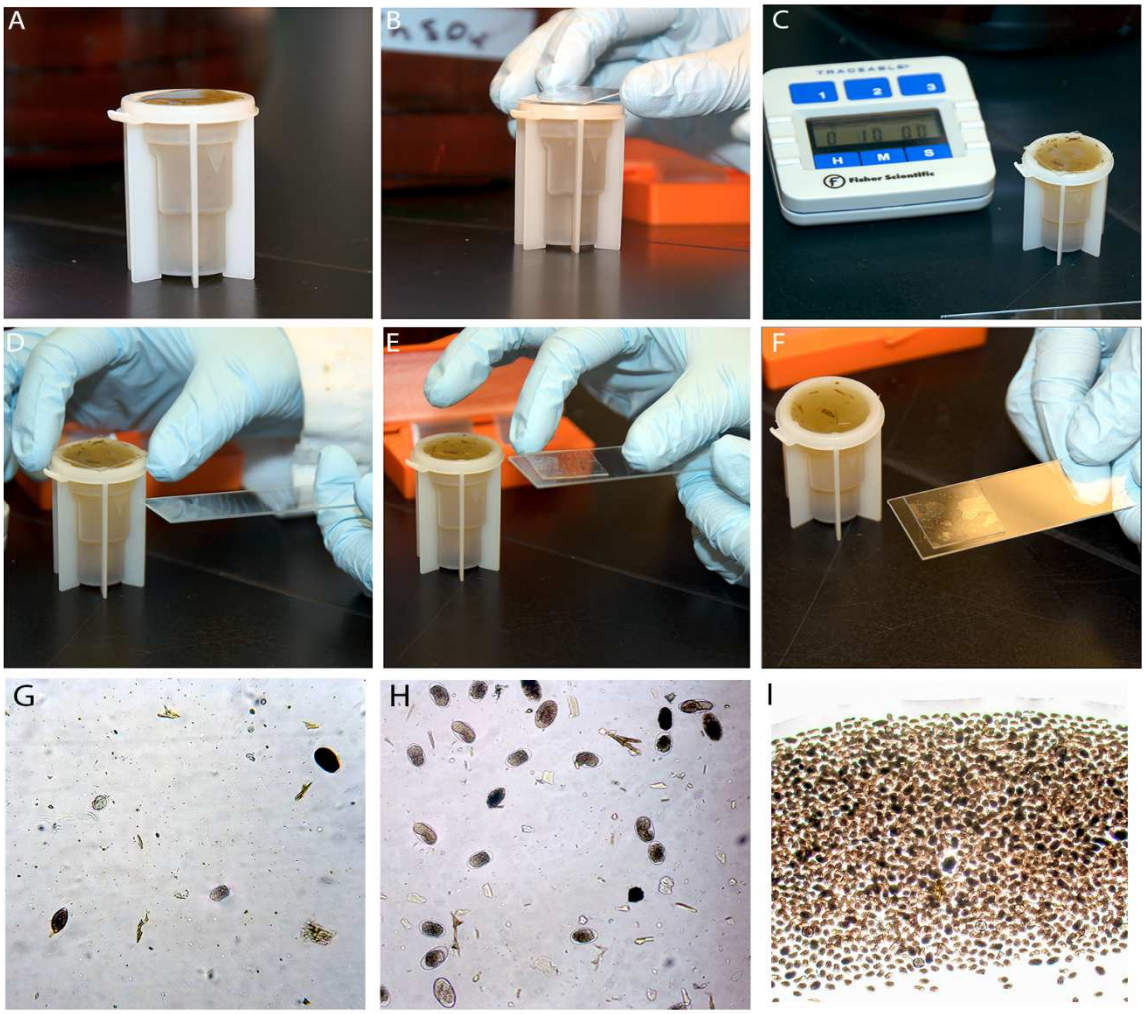


***Figure 1.  Fecal Float.  A) Feces and floatation solution mixture in vial with positive meniscus. B) Cover slip carefully placed on vial. C)  Allow to sit for 10 - 30 minutes. D) Carefully remove coverslip.  F) Place on slide. G) Positive float or +.  H) Positive float moderate or ++.  I) Positive heavy or ++++.***

The second class of FEC is the quantitative FEC. Quantitative FEC results are reported in eggs per gram (epg) of manure.The most common method of quantitative FEC for sheep and goats is the Modified McMaster technique mentioned in the introduction section.  Although there are several variations of the Modified

McMaster procedure(Coles et al., 1992; Cringoli et al., 2004; Foreyt, 2001; Ministry of Agriculture, 1977; Zajac and Conboy, 2012), all of the various methods use a weighed fecal sample, a known volume of flotation solution, and the specialized McMaster counting slide (Figure 2A). The two chambers of the slide are filled with the manure/flotation mixture and then thetrichostrongyle type eggs under the two McMaster chamber grids are counted (Figure 2B).

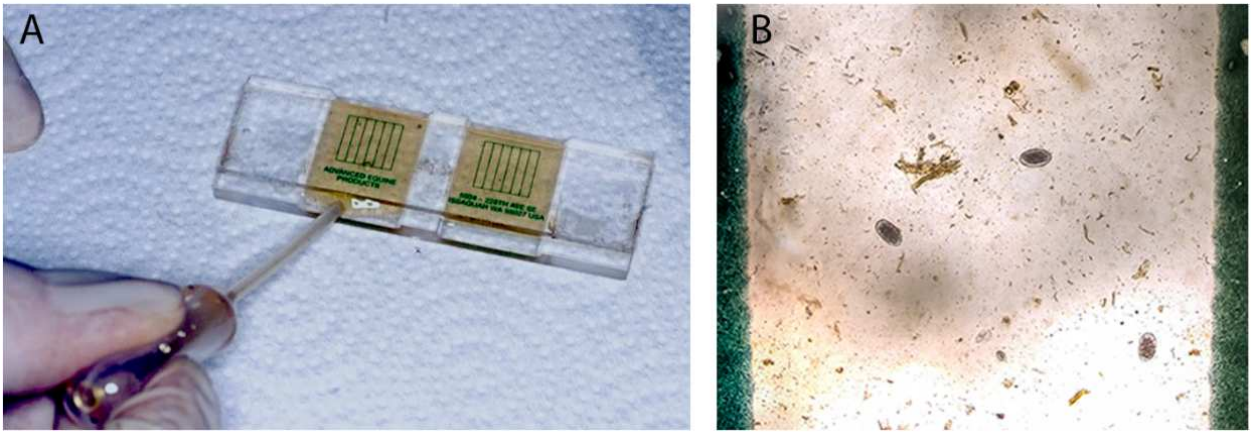


***Figure 2 A) McMaster slide being filled with flotation mixture. B) View through a compound microscope at 100X of McMaster chamber with trichostrongyle eggs present.***

Non trichostrongyle eggs, such as tapeworm, whipworm, and coccidian oocysts are noted, but not actually counted (See Figure 3). The total trichostrongyle type eggs counted under both grids are multiplied by a dilution factor that is determined by the concentration of feces in the floatation solution. This dilution factor is procedure/protocol specific and is determined by the weight of the feces, the volume of the floatation solution that the feces were dissolved in, and the volume of this mixture visible under both of the McMaster chamber grids. This may sound a little complicated, but quantitative McMaster counts are no more difficult to perform than simple flotations, and the equipment is relatively inexpensive and reusable – many producer cooperatives and breed groups that I work with purchase a microscope and McMasterslides for the group, and allow the members to share them. An equipment list and detailed instructions for performing fecal egg counts can be found on the American Consortium for Small Ruminant Parasite Control (ACSRPC) web site at www.wormx.info or www.acsrpc.org.

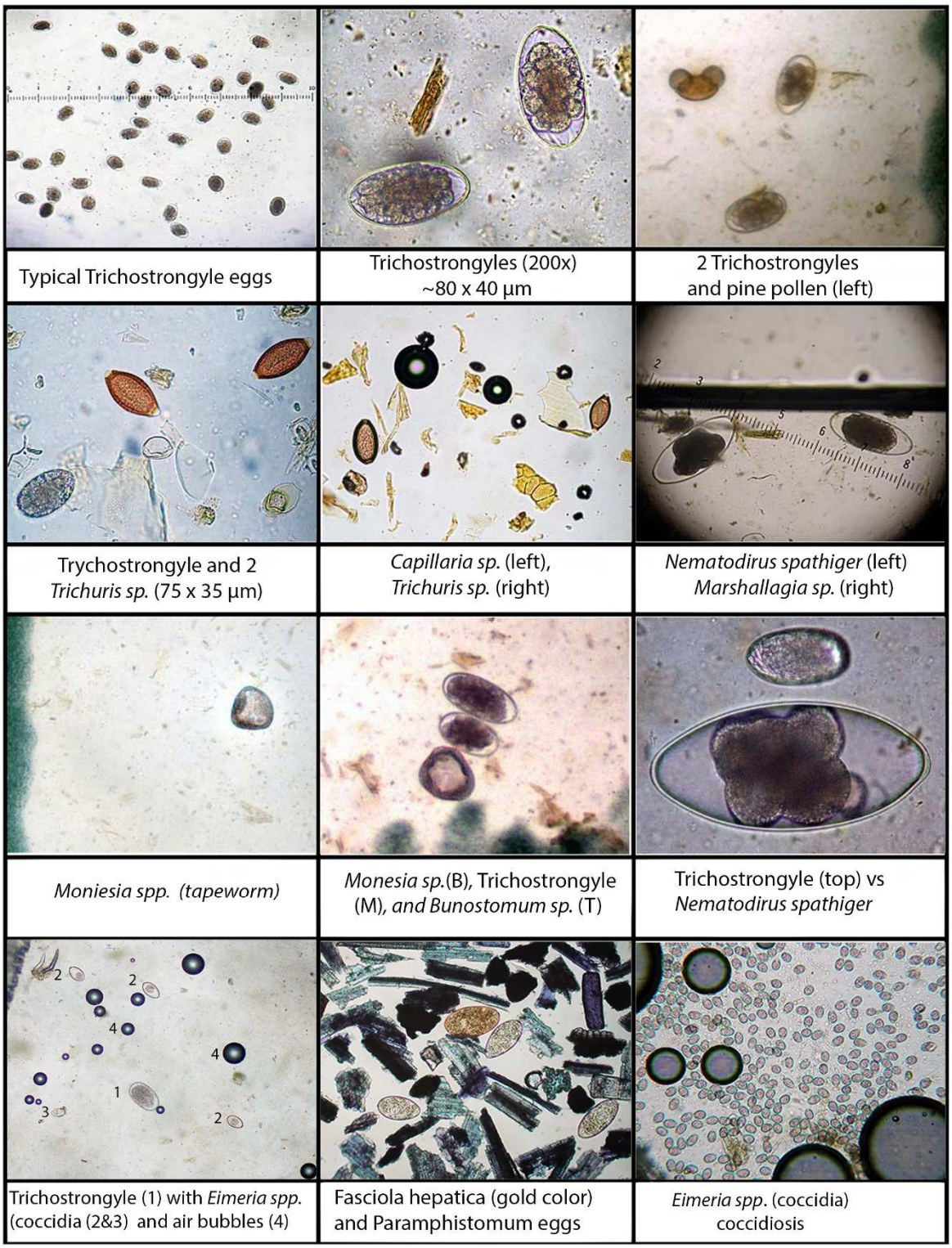


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*Figure 3 Common eggs and oocysts of small ruminants*

**What does a FEC tell us?**

A single FEC provides us with an estimate of the number of target parasite specieseggs present in a particular fecal sample. Since our major interest is sheep and goats, our target species are the Trichostrongyles, which includes any worm of the genus Trichostrongylus; however, since we are mainly interested in sheep and goats for our discussion the term trichostrongyles will be limited to*Haemonchus spp., Trichostrongylus spp., Ostertagia spp.,Teladorsagia spp., Oesophagostomum spp.*, and *Cooperia spp.*. It is not possible to visually differentiate the eggs of the aforementioned species accurately due to the similarity inof the size and shape of their eggs, so the epg value determined by FEC for a sheep or goat is only for thesetrichostrongyles. Other species that can be seen on FEC that can be readily identified (and quantified if desired) are *Nematodirus spp.*, *Chabertiaspp.*,*Bunostomumspp*,*Strongyloiedsspp, Trichuris spp.* (whipworm), *Monezia spp*. (tapeworm), *Eimeria spp.* (coccidia), *Marshallagiaspp,* and *Capillaria spp*. The species listed in this section is not by any means intended to be complete, but does reflect the most commonly encountered species in sheep and goats(Foreyt, 2001). Another important fact concerning FECs is that just because no eggs are detected on the slide, does not mean the animal is free of gastrointestinal parasites. The failure to see eggs can result not only fromthere being only a few parasites present in the animal or using an egg counting technique that is not sensitive enough, but also from the random chance no eggs were deposited in the particular portion of feces collected as a sample. Also, one must bear in mind that the egg per gram (epg) value determined by a FEC represents a snapshot in time of the specific fecal sample tested for a given animal,and that it in actuality tells us very little about the actual worm burden of the animal. Logic would suggest that a high egg count means a high worm count, but we are dealing with a biological system where many factors affect the actual egg production rate of female worms. First and foremost, different parasite species exhibit differing rates of fecundity (eggs production) as can be seen in Table 1.

| Nematode | Daily egg production/female |
|---|---|
| ***Haemonchus*** | 5000-15000 |
| ***Ostertagia, Trichostrongylus*** | 100 - 200 |
| ***Cooperia*** | 1000-3000 |
| ***Nematodirus*** | 50-100 |
| ***Oesophagostomum, Chabertia*** | 5000-10000 |

***Table 1. Daily egg production ranges of female trichostrongyles Source(Hansen and Perry, 1994).***

Other factors include the number of mature adult parasites established in the GI tract of the animal, the host animals level of immunity, the age of the host animal, the sex and the pregnancy status of the host animal, the developmental stage of the parasite infection, the species of parasite(s) present in the host, as well as the

consistency of the feces(Düwel, 1990; Hansen and Perry, 1994).Also, in addition to all of the previously mentioned factors affecting parasite egg production, one must also be mindful of the many factors affecting egg distribution in the feces. Digested material does not flow through the alimentary canal at a constant rate, female worms do not lay eggs continuously, nor are they are timed or synchronized with other females in their release of eggs. So, the actual egg count achieved for a given fecal sample depends on a lot of variables. Regardless of all of the above, *Haemonchus contortus* and *Trichostrongyluscolubriformis* worm burdens are generally considered to correlate with fecal egg count(Cabaret et al., 1998); however, the diagnostic significance of FECs and/or worm burden profiles for the purpose of treatment decisions should not be considered in a vacuum, but should be evaluated in relation to the history and management of the flock and be supported by an assessment of the presence or absence of clinical signs and indications as one would detect with the Five Point Check (Bath et al., 2010). Regardless of all of the caveats and limitations, FECs,when used in context with observation and other common integrated parasite management techniques, do provide us with valuable information for the management of parasitesin our herd or flock.

**So why perform FECs?**

Regardless of all of the apparent limitations and variability associated with FECs, there are three things that FECs help us determine, and they do so quite well. The first and most important is monitoring the efficacy of your anthelmintics – resistance detection. If a group animals has a high fecal egg count and is treated with a particular drench or combination, and then 10 days later a follow up FEC shows a zero or extremely low FEC (less than 5% of the pre-treatment value) for that group, then you can be fairly assured that your drench or combination worked(Coles et al., 1992). I invoke the inimitable words of Dr. Ray M. Kaplan concerning this fact, “DEAD WORMS DO NOT LAY EGGS”.

The second use of FECs is that they can provide information for monitoring pasture contamination. Routine FEC surveillance can provide information to a producer as to how fast the parasite contamination is building up on a pasture. This information can then aid in making decisions as to when to move animals off of a pasture to avoid a potentially dangerous parasite situation, as well as to provide valuable knowledge for determining whether a previously used pasture would be suitable for re-use during that same grazing season. For example if a pasture is grazed for a couple of months early in the grazing season and average FECs were high, then it very likely has a high level of contamination of infective larvae and therefore would not be suitable for grazing lambs or kids in mid-summer.

And the third is to aid in selection of animals that exhibit resistance to worms, or exhibit resilience in the face of a worm challenge.Resistance to parasites and resilience in the face of a parasite challenge are both heritable traits(Baker, 1999), and aid in the selection of animals exhibiting these traits. An animal with a consistently low FEC and low FAMACHA scores and rarely needs drenching compared to his herd mates exhibits signs of resistance. But in the same herd, and animal with consistently low FAMACHA scores, good body condition scores, and routinely has FECs in the 10,000 range is resilient and also a heavy pasture contaminator. Both of these animals are productive animals, but one is more desirable than the other. Without the information from the FEC, you would not know whether the trait you were seeing is resistance or resilience (personal experience).

**Conclusion/Summary:**

FECs are a widely used technique for quantifying parasite eggs in feces and is used for both clinical parasitology and research parasitology. The FEC is also used by farmers and producers to provide information relevant to parasite control in their sheep flocks and goat herds. The FEC is a simple test procedure that can be either qualitative (yes or no) or quantitative (# of eggs per gram) type. Both provide useful information, but for the sheep or goat farmer the quantitative variety provides more useful information in that all grazing animals have parasites, so the answer to the question “Do my animals have parasites?” is a given. FECs provide a snapshot in time of the number of parasite eggs in a given fecal sample, but does not provide accurate estimation of worm burden in the animal beyond the assumption that a high fecal egg count implies a high worm count. A FEC result that is negative or less than the minimal sensitivity of the test performed does not mean that the animal is free from parasites. The FEC provides its primary value to the farmer or producer as a tool for monitoring anthelmintic /dewormer/drench efficacy – resistance detection, the ability to monitor the rate at which eggs are being deposited on the pasture – pasture contamination, and it also provides additional data for detecting the genetic traits of resistant or resilient animals for animal selection/breeding. The FEC, when used properly, is a very fine tool for the producer to add to his parasite management tool box.

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