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Review article

Some factors influencing dressing percentage in goat meat production

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ABSTRACT

This review article looks at the factors affecting dressing percentage in goats. Many factors can affect the dressing percentage (DP), therefore it is important for goat producers to understand the concept and factors influencing dressing percentage because it can equate to profitability. In general, goat genotypes that are heavier muscled have a higher dressing percent than goat genotypes that are lighter muscled. Additionally, as the goat fat thickness on the outside of a carcass increases, the dressing percent also increases. Dressing percentage is based on the relationship between the dressed goat carcass weight and the live weight after things like the hide and internal organs have been removed. Goat dressing percentage can be calculated by taking (weight of the carcass / weight of live animal) * 100. This can be determined on a hot carcass weight or a cold carcass weight. There are indication of the potentiality to manipulating some of the factors that influence dressing percentage in goat to the producer's advantage. Better goat rearing practices can be achieved through nutritional management resulting in improvement of dressing percentage.

1. Introduction

It is obvious that dressing percentage as important as it is in evaluation of meat yield of goat and other farm animals is influenced by such factors as breed, sex of animal, nutrition and other management factors (Kalc et al.,

2012). Dressing percentage is both a yield and value-determining factor and is therefore an important yardstick in assessing performance of meat producing animals (Yusuf et al., 2014) hence an indication of how much meat a carcass will yield. This implies that it is a measurement of the weight of the carcass compared to the live weight of the animal (Dressing percentage (DP) = (hot carcass weight/live weight) x 100). Dressing percentage values on the empty body weight basis are higher than that of slaughter weight basis. Literature reports indicates that dressing percentage in goats varies between 38 and 56% by breed, sex, age, weight and conformation (Anjaneyulu and Joshi, 1995; El Hag and El Shargi, 1996; Dhanda et al., 1999; Getahun, 2001). According to Devendera and Burns (1983), dressing percentage is affected by plane of nutrition and other factors such as breed, age and sex. Pralomokarn et al. (1995) also indicated that dressing percentage increased as feed intake increased. Nutrition is predominant, because changes in goat diets may improve both the quantity and quality of the goat meat as a final product (Geay et al., 2001). There is a world wide tendency for rapid increase in demand for goat meat (Stankov et al., 2002) due to several reasons including the desire for leaner meat by consumer (Potchoiba et al., 1990), a good source of desirable fatty acids (Banskalieva et al., 2000) and reducing the risk of cardiovascular disease (Stankov et al., 2002). It is suffice to mention that dressing percentage is affected by what parts of the goat are being included in the carcass weight namely the hide, head, internal organs (heart, kidney, liver, etc.) and other factors that influence dressing percentage include, but are not limited to, gut fill and carcass fat. Payne and Wilson (1999) suggested that the definition of dressing percentage that excludes edible offal, reduces the relative contribution of goat meat to the national meat supply. Other factors that can negatively influence dressing percent are mud or manure on the hide, gut fill, amount of bone, unshorn wool, horns, abscesses, or bruises (Schweihofer, 2011).

2. Slaughter weight and age influencing dressing percentage in goats

The increased slaughter weight accompanied the feeding period from 83 to 139 days and, although not significant, showed slight increase in dressing percentage between groups, while age had positive and significant influence on deposition of subcutaneous fatness (Kalc et al., 2012). Kids of greater slaughter weight had greater carcass weight and greater weight of internal organs than kids of smaller slaughter weight influencing the variation in dressing percenatge. Marichal et al., (2003) and Santos et al., (2008) showed that dressing percentages and muscle content increases with age/weight in kids of various genotypes and slaughtered at 6–25 kg and 7–13 kg, respectively, while carcass conformation and fatness score improves with the carcass weight increased. Kids of greater slaughter weight also had a lower dressing percentage than lighter kids, although the differences were not statistically significant. Similarly, Marichal et al (2003) established that a lower dressing percentage in Canary kids of greater slaughter weight (25kg), which they explained by the fact that lighter kids did not have a fully developed digestive system. The effect of slaughter weight on dressing percentage was significant, probably because the animals were slaughtered at lower weights or compared in smaller weight ranges, which is in agreement with Santos Silva et al (2002). The influence of slaughter weight on those indicators was reported by Marichal (2003) in kids of different slaughter weights. However, Beriain et al (2000) reported a decrease in dressing percentage with the increase in slaughter weight, as the lightest animals did not have fully developed digestive tracts. As might be expected, heavier animals had heavier skin with lower legs weight, which may be attributed to the larger skin surface due to larger body size. In comparison with the Croatian Spotted kids included in their study, male Balkan goat kids in Macedonia (Milevska, et al. 2010) weighing an average 10.84 kg at slaughter had a higher average dressing percentage. Marichal et al. (2003) found that goats with a live weight at slaughter of 6 and 10 kg had a lower dressing percentage than goats with 25 kg live weight at slaughter, due to an in completely developed digestive tract in the lower live weight goats. Dressing percentage, carcass length and , Longimus dorsi area significantly increased with increased in pre slaughter weight, however having the proportion of inedible offal viz., blood, head, skin, feet and alimentary tract decreasing with increase in bodyweight (Sivakumar, 2013). The dressing percentage was significantly higher in higher weight groups (15 to 18 kg) than lower ones (12 – 15 kg) (Sivakumar, 2013). This was in agreement with Prasad and Agnihotri (1992) who reported a similar trend for dressing percentage in Barbari goats. However, other investigators in the same ecological zone (Ifut et al., 2011) reported lower values of dressing percent of 38 - 42 % for West African Dwarf goats of 9-12 kg live weight.

Assan (2012) observed an increase in proportion of edible meat offals as a percentage of hot carcass mass as age increased indicating tendency of excessive fat deposition on internal organs in older animals, which might have an influence on dressing percentage, although this was in disagreement with the findings in literature by Singh et al. (1991). Body condition score was highest at the slaughter age of 6 years and, kidney fat and fat score increased

with increased age in Matebele goat. This scenario indicates that there is a tendency of excessive fat deposition in older animals above the age of 3 years than young animals in indigenous Matebele goats. At the ages below 3 years fat deposition is minimal as a result goat slaughtered under this age will be suitable for lean meat production because they can attain a reasonable slaughter weights without the risk of becoming excessively fat. This confirmed the findings reported elsewhere (Biswas et al., 1989) where fat percentage increased as age at slaughter increased hence influencing dressing percentage. The kidney fat and intestinal (omental) fat increased with increasing slaughter weight particularly between 35 and 40 kg (Economides and Olymbios, 1991). Dressing percentages were lower than those reported by Mayi (2009) for Meriz and goat slaughtered at a heavier weight (25.08 kg for Meriz and 39.31 kg for goat). The non-significant differences in dressing percentage were in accordance with those reported earlier by Mokhtar et al (1996) and Al-Doori (2006). However, breed differences in dressing- out percentage based on empty body weight or lack of them are influenced by degree of gut fill at slaughter (Kadim et al.,2003).

3. Nutrition and management system influencing dressing percentage in goats

Nutrition influences dressing percentage through variation in weight of gut contents, or variation in actual organ weight (Warmington and Kirton, 1990). Similarly, Shaljhal (2000) reported that gut fill could constitute 20 - 22% of live weight. The dressing percentage on an empty body weight basis differed on diet (Sebsibe et al., 2007). Kumar et al. (1991) observed that the plane of nutrition did not significantly affect carcass weights, dressing percentage and proportions of cuts in Gaddi goats at the age of 14 months. This was partly in agreement with reports by Reddy and Raghavan (1988), Hatendi et al. (1992), El Hag and El Shargi (1996) and Sheridan et al. (2003) who reported similar effects on DP on SBW and / or carcass weights. Dressing percentage on empty body weight basis was significantly higher in unsupplmented group compared to supplemented groups and this was due to the higher gut content (Gebru, 2014). Dressing percentage increases with increasing proportions of concentrates in the ration. High percentages of crude fiber and roughage with low digestibility that contribute to low dressing percentages (Payne and Wilson, 1999). Dressing percentage in both experimental years was affected by concentrate level, the more concentrates (40 %) the higher dressing percentage (Rahmann and Aksoy, 2014). Increasing crude protein concentration of diets resulted in higher dressing percentage in wether goats (Shahjalal et al.,1992), similar to those observed in the alfalfa-hay fed animals in another study by Wildeus, et al. (2007). Balance of absorbed amino acids is the most important factor affecting the efficiency of protein utilization for production of meat and other products (Cole and Van Lunen, 1994). Lean tissue deposition is maximizing by optimal protein supply (McDonald et al., 2002). Feeding a higher level of forage in the diet generally results in a lower dressing percentage (Haddad, 2005; Moore et al., 2002). Increasing the level of a protein supplement containing maize bran, cotton seed, sunflower and sugarcane molasses (102, 150 and 177 g CP/kg DM) in the diet has been shown to decrease the dressing percentage in growing goats (Mtenga and Kitaly, 1990). When more fibrous material from E. variegata foliage was fed, rumen fill increased and consequently the dressing percentage was lower (Kongmanila, 2012). However, Mahgoub et al. (2005) indicated that increasing ME levels in the diet fed to Omani goats increased carcass weight, EBW and DP. Working with intact Boer bucks, the dressing percentage observed in goats fed on 1.5% APL was however, comparable to 46.70% as observed by Karami et al. (2010) and 46.33% as reported earlier by Ebrahimi et al. (2008) for Kacang goats fed 0.50% *Andrographis paniculata* leaf powder and 50% oil palm frond pellet, respectively. Dressing percentage of 48.71% observed by Ebrahimi et al. (2008) when Kacang goats were fed 25% oil palm frond pellet was similar to that which was reported for goats fed *Andrographis paniculata* plant. Wildeus et al. (2007) reported higher carcass dressing percentage for Spanish and Boer goats fed grass and alfalfa-hay-based diets with limited concentrate supplementation. This points to the fact that nutritional composition might influence dressing percentage in goats. Yusuf et al., (2014) the inclusion of *Andrographis paniculata* significantly improved feed intake, weight gain, feed efficiency and live weight. The ratios of carcass to fat, lean to bone, lean to fat, and composition of meat were also improved. In addition, there were significant differences between their dietary treatments in dressing percentage. reported that goats fed *Andrographis paniculata* leaves and whole *Andrographis paniculata* plant were within the expected range of 43.9% to 55.7% as reported for Boer goats, South Africa indigenous, Angora and Kacang crossbred goats (Ebrahimi et al., 2008; Johnson et al., 2010). The increased slaughter weight accompanied the feeding period from 83 to 139 days and, although not significant, showed slight increase in dressing percentage between groups. These results are in agreement with results of Mayi and Alkass (2010) of Meriz and Blackgoat kids who pointed out that dressing

percentage of goat increased with body weight and age. It was concluded that daily zilpaterol hydrochloride supplementation at 0.20 mg/kg BW increases growth performance, feed efficiency, and dressing percentage in castrated goats as a result of greater muscle accretion and causes reduction of fat and visceral organ mass (Hatefi, et al. 2015).

Daskiran et al., (2006) reported that the dressing percentage of intensively raised Norduze male kids (42.94%) was 3.32% lower than that of kids raised on pasture. Such difference may be attributed to variations in weight of digestive tract content (Dhanda et al.,1999). Kor (1991) and Ertugrul (1994) observed that the dressing percentages of goats raised in pasture conditions was lower than that of intensively raised ones. The dressing percentage based on live body weight and empty body weight of intensively raised kids (42.42 and 50.41%) and semi-intensive group (40.24 and 49.66%) were significantly ($p<0.01$) higher than that of kids raised on pasture (30.61 and 42.14%) (Kamal, 2010). Intensively and semi-intensively raised kids had significantly higher carcasses, dressing percentages, larger eye muscle area and thicker of fat thickness than those raised on pasture. Fatness -an increase in one fat score will increase dressing percentage by about 2.5%, fatter kids also suffer less live weight and carcass weight loss from fasting prior to slaughter than do leaner kids. Dressing percentages (calculated as (hot carcass weight / liveweight) * 100) can vary widely for goat kids from about 35% to 55% with 45% being average for most kids with no Boer breeding. Kids with higher fat scores generally have higher dressing percentages than kids of the same live-weight with lower fat scores (Greenwood, et al. 1996). The dressing percentage of Central Highland goat was lower probably due to the lesser quantity of fat in the same genotype (Sebsibe et al., (2007). In general, animals that are heavier muscled have a higher dressing percent than animals that are lighter muscled. Additionally, as the fat thickness on the outside of a carcass increases, the dressing percent also increases (Schweihofer, 2011). When the animal grows, the fat percentage will increase and the percentage of bone decreases. The percentage of lean muscle doesn't change much and the legs and the shoulder of the goat tends to have the highest muscle mass on the animal (Luginbuhl, 1998). Marichal et al. (2003) found that goats with a live weight at slaughter of 6 and 10 kg had a lower dressing percentage than goats with 25 kg live weight at slaughter, due to an in completely developed digestive tract in the lower live weight goats.

4. Genotype and dressing percentage in goats

Stanisz, et al (2009) and Alexandre, et al (2010) reported average range of dressing percentage between 40.63 % to 52.50 % in goat kids of various genotypes. However, Kosum et al (2003) found a slightly higher average dressing percentage in Saanen (52.20%) and Bolnova kids (55.19%). Nwachukwu, et al (2015) observed the dressing percent of 48.20 and 47.85 % recorded for buck and doe kids, respectively, which were within the range of 45 - 49 % reported by Hassan and Idris (2002) and Jibir et al. (2012) for growing Red Sokoto and Sahelian goats. While, Sharma (2003) had noted that the dressing percentage of goats in New Delhi area of India varied from 43 to 48 % depending on breed and management practices applied. The dressing percentages by Nwachukwu, et al (2015) were less than the range of 50 – 51 % reported by Ukanwoko and Onuoha (2011) for West African Dwarf goats fed oil palm and leaf meal in the humid tropics and values of 50-52.6 % reported by Ahamefule (2005) for mature West African Dwarf goats. Breed affected the dressing percentage that ranged from 42.5 to 44.6% and 54.3 to 55.8% on slaughter body weight and empty body weight basis, respectively. The dressing percentage of local goat breeds in Lao PDR ranged from 43-50%, while it was 51-58% in seven different goat breeds in an earlier study (Dhanda et al., 2003; Mahgoub and Lu, 1998). Sebsibe et al., (2007) working with three Ethiopian goat breeds fed grainless diets varying in concentrate to roughage ratios observed that breed had a significant effect on most of the carcass parameters, while dietary effects were statistically similar for most traits, except for dressing percentage and some non-carcass components. Although dressing percentage is extremely important to individuals who purchases live animals, it is not a very good indicator of the value of the potential carcass because higher dressing percentages might be often a result of much fatter carcasses. This is less true for goats unless they are excessively fat. This is because goats carry the bulk of their fat internally and this internal fat drops out with the gut and internal organs when slaughtered. Dressing percentages (calculated as (hot carcass weight / liveweight) * 100) can vary widely for goat kids from about 35% to 55% with 45% being average for most kids with no Boer breeding. Kids with higher fat scores generally have higher dressing percentages than kids of the same live-weight with lower fat scores (Schweihofer, 2011). Breed differences in dressing percentage or lack of them are influenced by degree of full gut at slaughter. On a slaughter body weight basis Long-eared Somali and Afar goat had higher and similar DP, whereas Central Highland goat had the lowest DP (Sebsibe et al., 2007).

5. Gender and castration influencing dressing percentage in goats

Dressing percentage (51 vs. 47%) were higher in wethers vs bucks, respectively (Solaiman et al. 2011). Although bucks had higher final and harvest body weight, they failed to produce higher dressing percentage when compared to wethers. Dressing percentage was higher in young intact males of Spanish breeds compared with Angora breed (Nagpal et al. 1995). Differential body tissue growth in bucks and wethers may contribute to higher non-edible body parts that lowered dressing percentage in bucks and higher proportion of carcass fat in wethers that may have contributed to higher DP in wether goats. Goats generally tend to have a lower DP compared to sheep (Tshabalala et al., 2003). Assan (2012) observed that sex had an influence on dressing percentage which was explained by the fact that does had a higher fat score that intact males. Intact males and castrated males had a higher dressing percentage than does which is congruent with findings of Raghavan (1988) where dressing percentage was generally lower in females than in males. In agree with Peña, et al (1994) and Santos et al. (2007), dressing proportion was higher in females, which can be explained by their tendency to have a higher fat deposition in the carcass. On the contrary, Pérez et al. (2001) recorded higher values in males than females (54% vs. 50%). The differences between these studies may be due to the type of diet and weight at slaughter. These findings were consistent with Rao et al., (1988) who observed an influence of sex on dressing percentage in Jamnapari and Barbari goats. Elsewhere, higher slaughter weights in intact males and castrated males improved dressing percentage and this confirms the findings of Manfredini et al (1988) goats.

The dressing percentage was not significantly affected by method of castration at 14 months of age, however, at 22 months of age, burdizzo and rubber ring castrates had significantly higher dressing percentages than control (Nsoso et al. 2004). These findings were supported by those of Singh et al (1996) on Beetal-Assam local goats, which indicated that castrates produced significantly more dressed percentages than entire males. In another study, Dawa et al (1996) in Cameroon reported that castrated males produced significantly heavier carcass (+0.21kg) and more meat per 100kg live weight (+3.9kg) than females. These findings corroborates with those finding by Owen et al (1978) on indigenous Tswana goats, were they found that indigenous castrated goats were significantly larger and heavier carcasses than entire males. Farmers should castrates animals destined for slaughter at later ages. This implies that castration is a useful technique for increasing the rate of maturity of late maturing indigenous breeds and therefore farmers should take advantage of this. However, castration efficiency is also a function of other parameters such as time of castration, method of castration, environmental conditions during the fattening period and types of animals castrated (Zamiri et al., 2012). The effect of castration on dressing percentage has also been inconsistent (Allan & Holst, 1989; Mourad et al., 2001; Koyuncu et al., 2007). Castration has generally resulted in an increase in fat deposition in the body (Bayarktaroglu et al., 1988; Abdullah & Musallam, 2007), but there have also been reports indicating no significant effect of castration on fat accretion (Tahir et al., 1994). Comparing the results of studies evaluating castration effects in goats and sheep, it could be concluded that the castration might be more recommendable in goats than sheep. Castration in goats has the potential to decrease unfavorable flavor and odor of goat meat. For example, castrated goats were superior in terms of meat aroma, flavor and tenderness when they have been compared (Zamiri et al., 2012). Peña et al. (1994) who found a significant effect of slaughter weight on fatness but not of sex. Differences in conformation, internal fatness and subcutaneous fatness between male and female kids were not significant. Although mean values of dressing percentage between sexes were not significant, female kids (47.1%) had slightly higher values than male kids (45.2%) which could be explained by their tendency to have a higher fat deposition in the carcasses. The average dressing percentage was observed to be higher in the rams, being in, <1 year category, which can also be ascribed to better skeletal structure and muscularity vis- -vis the ewes, the values being non-significant in the higher (>1 but <2 years) age category (Kefyalew et al. 2013). The trend was also observed in does >1 year but < 2years of age, where the stomach and the intestines (along with the contents) were higher in the does, this be ascribed to compensatory growth of the stomach and intestines when the animal consumes poor quality roughages as the rams are frame of the rams are larger (observed by larger size of the skin and trotters) than the ewes and they are able to obtain the better part of the forage. This is in contrary with Nwachukwu , et al (2015) who observed that carcass characteristics were however significantly higher in bucks than does while dressing percentages were similar in both sexes.

6. Implications

It can be concluded that there is variation in dressing percentage due to definable environmental factors and management, therefore it is important for goat farmers to understand the concept of dressing percentage because this information can be utilized when setting prices and calculating profitability for any goat enterprise selling meat animals. However, it is not necessary to calculate a dressing percentage (often live animal weight is unknown) (often either hot or cold carcass weight is unknown) when selling livestock directly to the consumer. It has been noted that it is difficult to compare values of dressing percentage from different studies because different slaughter methods are applied in these studies which has a profound influence on the values of dressing percentages. Genotype differences in dressing percentages is a result of fat accretion which influence the muscle to fat ratio, however this is not independent of other factors such as weight at slaughter and age. The influence of slaughter weight in goats emanates from the fact that higher slaughter weight contributes to higher carcass weight and the higher weights of the stomach and intestines, lungs and heart and liver. In general, animals that are heavier muscled have a higher dressing percent than animals that are lighter muscled. There is a suggestion that goat meat production should emphasize the need to pay attention to the total yield of usable products, rather than the carcass weight and dressing percentages alone, in cultures where edible offal component is traditionally consumed. It can be concluded that the dressing percentages of different goat breeds differ and can be improved to some extent by both feeding and management. Goats raised solely on grazing with lack of dietary supplementation can result in depressed growth and thereby affecting the dressing yield of goats.

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