ORGANOLEPTIC AND PHYSICO-CHEMICAL EVALUATION OF CAPRETTO BALADI GOATS: A VALUE-ADDED MEAT ALTERNATIVE IN AN EXTENSIVE REARING SYSTEM

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ABSTRACT

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The local Baladi breed is considered a common source of fresh meat in Lebanon. Due to the extensive rearing system and the scarcity of pasture, kids resulting from multiple births are not reared, though cultural preference for young meat may valorize these twin kids as an expensive delicacy. Few studies observed growth parameters, physical-chemical and sensory properties of meat in Baladi kids. Therefore, 24 male Baladi kids were fed milk ad libitum post-natally for 24 days, after which 9 were randomly selected and fed pasture grass ad libitum and goat milk (Control), and 15 were fed only milk (Capretto) twice per day. Animals were slaughtered at 4, 6 and 8 weeks of age and body organs compared. Feed intake was measured by weighing kids pre- and post- feeding, and body weight measured twice per week. Meat chemical properties were total ether-extracted fat, kjeldhal protein, and minerals. Meat organoleptic properties were evaluated by consumers for color, taste, odor, richness, juiciness, tenderness and overall appreciation, as cooked by housewives or professionals. Data were analyzed as a CRD using SPSS 10.0 and presented as LSMeans ± SEM. Results showed that Capretto consumed increasing levels of milk from 4 to 8 weeks, with ADG decreasing ($P<0.05$) from 4 to 8 weeks. Capretto showed 5% less ($P<0.05$) weight than control kids. Carcass yield was higher ($P< 0.05$) for Capretto (44.5 ± 3.4 %) than control (36.3 ± 3.3%), with Capretto showing smaller viscera and lower hemoglobin. Both blood and meat (protein, cholesterol) composition did not differ ($P>0.05$) between Capretto and control, although capretto showed lower ($p<0.05$) meat fat content than control kids. Meat organoleptic characteristics were desirable at weeks 4 and 6 for both Capretto and control kids, whereas only Capretto meat stayed desirable at week 8. To conclude, Capretto kids have similar properties to their traditional counterparts, with added desirable properties for a longer growing period, in

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addition to the increased health benefit of lower fat content.

Keywords: Capretto, milk-fed, value-added meat, meat properties.

INTRODUCTION

Lebanon is characterized by narrow grazing areas and abundance of mountainous lands, with low management of pasture grounds. Goat rearing and goat meat consumption, especially of the local Baladi type, are among the socio-cultural traditions, with milk-fed kids considered an expensive and festive delicacy. However, goats' grazing patterns result in overgrazing, loss of natural pastures, irreversible damage to young trees, and depletion of reforestation efforts (Abi Saab, 1991). Also, fluctuating goat meat consumption, peaking during religious holidays (Abi Saab *et al*., 1997), leads to shortages in local goat meat availability and increased import. Goat population, estimated 430,000 heads (MOA, 2009) across Lebanon, accounts for only 35% of the local small ruminant meat demand (FAO MOA, 2005). Unfortunately, low genetic diversity of highly adapted Baladi herds, lack of availability of grazing grounds, overgrazing of the already scarce rangeland, as well as loss of weak twin kids is leading to low milk production, 49 % carcass yield, and reduced max weights of 65 - 70 Kg in bucks and 35 - 40 Kg in dams (Abi Saab *et al*., 1997). In the adopted traditional system of transhumance, only strong enough Baladi kids are kept for fattening, thus resulting in the elimination of up to 30 % of newborn, twin or weak kids (Hajj, 1999). These animals, if reared in a more intensive system, can generate some income to rural farming communities, and decrease the dependence on imported meat. The Lebanese meat consumer market demands meat from younger animals, implying preference for more tender meat and more desirable organoleptic properties. Goat meat acceptability was reported to be dependent on flavor, tenderness, aroma and juiciness, but not on pH and colour of meat (Naude and Hofmeyr, 1981). However, age (Smith et al., 1978) and breed (Dhanda et al., 1999b) impacted palatability with older goats, showing lower palatability, mainly due to lower juiciness (Smith et al., 1978). Despite this high demand for goat meat around the world and in Lebanon, little research has been conducted on rearing local milk-fed young Baladi kids (Capretto), and their physico-chemical, nutritional and organoleptic meat properties. Therefore, the objectives of this study were 2 fold: 1) evaluate growth rate, blood components and organ weights of Capretto as compared to their pasture counterparts, and 2) evaluate the physico-chemical, nutritional and organoleptic value of meat from such goats when slaughtered at different ages up until 2 months of age.

MATERIALS AND METHODS

24 newborn male goats were fed milk free-choice until 24 days of age, after which 9 kids were randomly selected and fed free choice pasture grass and goat milk (Control), and the remaining 15 kids were fed maternal goat milk (Capretto) twice per day (morning and evening) until day of slaughter. Kids were reared in a 70 x 70 x 70 cm3 stall at the experimental station of the Faculty of Agricultural Sciences, USEK, in the region of Jbeil-Byblos at a 100 m altitude. All animals were vaccinated for diseases, worms and parasites prevailing in the region. All protocols respected applicable guidelines for animal welfare, as per IACUC ethical standards.

Body weight was measured pre- and post-feeding twice per week, and amount of milk ingested per day, average milk consumed per week, and average daily gain (ADG) of kids were calculated. From each treatment two males were separated and slaughtered at 4, 6 and 8 weeks

of age, and the weight and yield of different body parts including carcass, skull bone, skin, limbs, gastrointestinal tract and internal organs recorded. Samples of jugular blood of kid goats were collected every 6 days during the first month and before slaughter using a sterile vacutainer syringe. Blood minerals were analyzed from 10 ml of blood placed in dry tubes without anticoagulant. Sodium, potassium, calcium, iron, glucose and serum proteins were analyzed from EDTA-blood using flame photometry and spectrophotometry. Blood hemoglobin concentration was determined calorimetrically by complexion with Drabkin reagent (Sigma, St. Louis, MO) following manufacturer's guidelines.

Furthermore, 300 to 400 g of meat samples were collected randomly from different parts of both Control and Capretto kids. Total fat was determined after ether extraction and drying at 100 °C, as the percentage of ether mass evaporated over used meat mass. Meat samples were tested for protein using Kjeldhal method, minerals estimated by carbonization of organic matter, and moisture by weight difference pre- and post-drying. Rigor mortis was carried out for 12 to 16 hours at 4 °C and cuts prepared by specialized cooks (tenderized grilled kabobs or pan-fried) or housewives (pan-fried, roast or stew). Organoleptic criteria were evaluated by a regular consumer panel who rated the meat based on color (red=1 to white = 4), taste (acid to nice), odor (not desirable to specific), and richness (low to high) or juiciness (1 to 5). Tenderness and overall appreciation were rated by housewives. Higher scores indicated better appreciation of meat quality.

Data were analyzed as a completely randomized design using SPSS 10.0, and means compared using the least square differences method and presented as least square means ± standard error of the mean (LSMeans ± SEM). Means were considered different when ANOVA was significant, and pairwise comparisons p-value was <0.05.

RESULTS AND DISCUSSION

Feed intake, growth, and carcass weights

For Capretto goats, average milk consumption (Figure 1A) was greatest in the first few postnatal weeks, from 566 ± 25 mL/d (wk 1) to 800 ± 50 mL/d (wk 4), therefore ensuring an ADG of 167 ± 5 g/d. Milk consumption decreased subsequently, driving smaller ($P<0.05$) BW in Capretto (8.8 ±0.4 Kg) than Control (10.00±0.4 Kg) by wk 8. Kids increased BW linearly from day 0 to day 24, with Capretto Kids but not Control decreasing ADG afterwards (Figure 1). Carcass returns and body parts comparisons are presented in Figure 1B as percentages within Control and Capretto. Throughout the study, Carcass percent was higher ($P<0.05$) in Capretto (45.4 ± 3.5 vs 36.3 ± 1.6 % at wk 4 and 43.5 ± 3.3 vs 36.7 ± 2.3 % at wk 6) than Control kids, but with a smaller ($P<0.05$) digestive system at slaughter and larger ($P>0.05$) skin at wk 8 in Capretto, and no other difference ($P>0.10$) in weights of body organs.

Morand-Fehr and Sauvant (1988) reported increased milk ingestion during the first 4 weeks of life in Shami goats. However, lower quantity and quality of milk is observed in Baladi *vs.* Shami goats, thus explaining the most likely species differences in milk consumption. Lower weights but higher carcass return in Capretto might be due to the much lower digestive system volume. Our findings include lower live weights, lower fat and no difference in other body parts in Capretto than Control in other genotypes and intercrosses than Baladi, in accordance with previous studies (Economides and Olymbios, 1991, Dhanda *et al.*, 1999a, Dhanda *et al.*, 1999c). However, our study showed lower viscera, unlike previous studies (Dhanda *et al.*, 1999a)

reporting no effect of genotype on viscera.

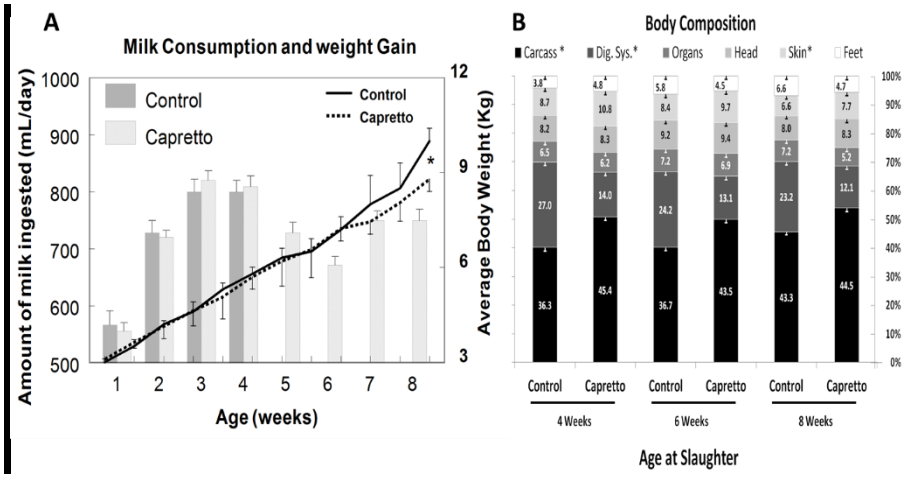

Figure 1. Milk consumption, body weight and carcass composition of Baladi kids.

Panel A: Milk consumption (Bars) was measured twice weekly as the weight difference of kids pre- and post-feeding. Average weight (in Kg, Lines) was calculated from weighing kids twice a week. *LSmeans for weight differ between treatments ($P < 0.05$). Panel B: Carcass and individual organs weighed and percentage of total calculated. *Within variable and age group, LSmeans differ ($P < 0.05$) between treatments.

TABLE 1

Serum Mineral and Organic Composition in Baladi kids

Treatment	Age (Days)	Na (mmol/l)	K (mmol/l)	Ca (mmol/l)	Fe (mmol/l)	Glucose (mmol/l)	Protein (g/l)
Control & Capretto	6	132.0±12.9	4.7±0.5	1.9±0.4	18.5±10.6	6.2±1.0	48.2±3.2
	12	144.8±8.9	4.8±0.1	2.1±0.3	22.5±7.8	5.6±0.8	50.2±2.1
	18	141.2±9.4	4.8±0.5	2.5±0.3	16.2±6.9	6.7±1.1	67.1±14.0
	24	140.7±16.3	4.8±0.6	2.4±0.2	13.2±2.0	6.1±0.2	72.4±16.4
Control	30	141.0±5.7	5.5±0.1	2.6±0.4	17.4±2.9	4.2±0.3	73.0±7.8
Capretto		139.0±9.0	5.0±0.1	2.5±0.3	19.6±3.1	6.8±0.1	67.4±16.4
Control	42	145.0±3.4	4.8±0.1	2.5±0.2	22.3±4.5	5.0±0.1	73.0±11.1
Capretto		141.0±1.0	4.9±0.1	2.4±0.1	16.9±4.0	5.6±0.1	75.0±8.5
Control	54	144.0±3.5	5.0±0.3	2.6±0.2	24.0±1.5	5.5±0.4	74.0±12.0
Capretto		142.3±2.0	4.9±0.1	2.4±0.1	17.0±1.4	5.6±0.2	78.5±10.9

*Within variable, LSmeans differ between treatments ($P < 0.05$).

Blood and meat characterization and composition

As shown in table 1, blood and meat composition in Na, K, and Ca did not significantly change between Capretto and control Kids. However blood iron level, though not different until Day 30, was afterwards lower (P< 0.05) in Capretto compared to control Kids, further supporting the differences in meat color between Capretto and control Kids. Blood protein levels increased from d 6 to d 54 in a similar manner between control and Capretto kids. Blood hemoglobin (Figure 2 B) increased from birth to d 24 but decreased afterwards, maintaining higher levels (p<0.05) in control than Capretto by wk 6 and 8.

In this study, there was no difference (P<0.10) between control or Capretto Baladi kids meat composition except for lower (P<0.05) fat in Capretto from birth to 8 weeks of age, indicating that feeding only milk to growing kids can provide the necessary nutrients for growth, and maintain good hemoglobin with no signs of anemia despite lower iron levels. Verzgula et al. (1985), Un (1986) and Bennis et al. (1994) showed similar results in other domestic species grown on a mixed diet for a similar period. Levels of protein ash, water and mineral content similar to those in our study were shown in Saanan (Colomer-Rocher and Kirton, 1989), Asiatic (Devendra, 1988) and Damascus (Economides and Olymbios, 1991) goat species. In addition, Dhandra *et al.* (1999d) have reported higher unsaturated fat in Capretto than Chevron (milk+hay diet), adding to the health benefits associated with Capretto Kids, much in agreement with this research.

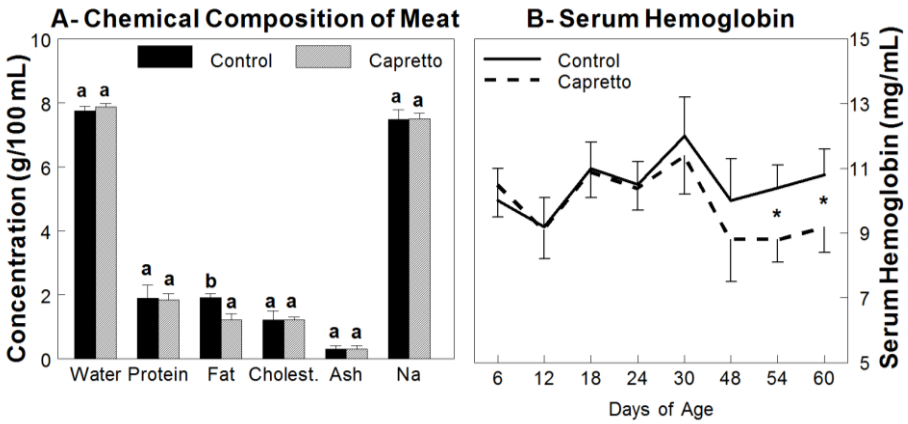

Figure 2. Average meat and serum composition in Baladi kids.

Panel A: chemical composition of meat in Baladi Kids. Cholest. = cholesterol, [a, b] Within variable, LSmeans without a common superscript differ (P < 0.05). Panel B: Serum hemoglobin levels from serial jugular blood samples collected d6 to slaughter. * Within age group, LSmeans differ (P < 0.05).

Organoleptic evaluation of Baladi kid meat

Meat color from Capretto kids was pinkish and significantly lighter (P<0.05) than its control counterparts, especially at 6 and 8 weeks of age, with a more (P<0.05) specific and

pleasant smell. No difference in flavor (p>0.01) between control and Capretto was detected when evaluated by a sensory consumer panel. Chewing, juiciness and overall appreciation were best (P<0.05) in Capretto than control when slaughtered and grilled at 8 weeks of age. No significant difference (P>0.10) was observed among Capretto and control when meat was pan cooked (Figure 3).

Regardless of cooking method, Capretto received higher scores (P<0.05) than control meat by housewives. These results indicate the successful production of Capretto Kids of the Baladi breed, which keep the characteristics of young meat with improved tenderness and juiciness as late as 8 weeks of growth. Juiciness and tenderness were similar in Control to previous reports (Schonfeldt et al., 1993, Swan et al., 1998) on younger animals and goats. Previous research (Casey and Van Niekerk, 1988, Colomer-Rocher and Kirton, 1989, Dhanda et al., 1999b) reported meat quality variations with genotype in goats. With Baladi Capretto showing good growth and lower fat content compared to its counterpart control kids, this breed can be an economically valid alternative to transhumance and loss of valuable resources, in addition to health advantages (Julla, 1988).

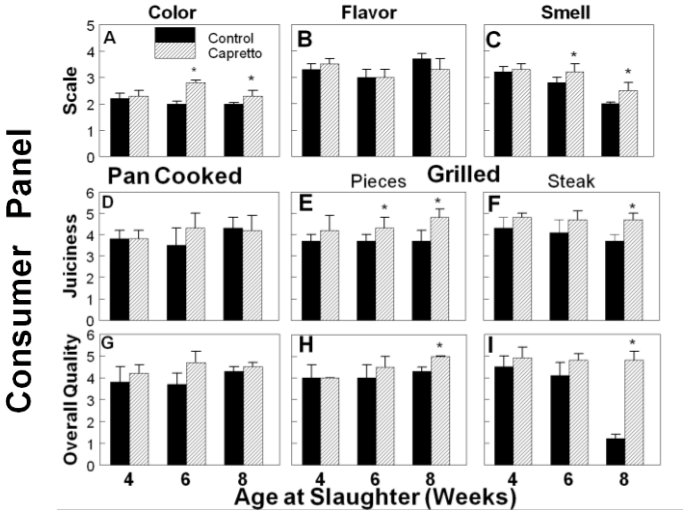

Figure 3. Sensory and organoleptic evaluation by a consumer panel of pan cooked or grilled Baladi kids' meat.

Higher score is best. All meat was judged following cooking by housewives and professional cooks. *Within variable and slaughter age, LSmeans differ (P<0.05) between treatments.

Carcass return and quality in Baladi Capretto was highest at week 8, with a good average daily gain as compared to hay fed Control kids. Management and feeding of Baladi Capretto does not appear to alter blood characteristics or meat mineral and organoleptic properties to 6 weeks of age. Furthermore, this white meat is high in protein and low in fat, a desirable quality product for consumers with cardiovascular health problems. The consumer

taste panel showed a high preference for this type of milk-fed kids and therefore Capretto could constitute a tasty healthy alternative to meat. In Lebanon and the Middle East, Capretto meat return is of high potential as compared to contemporary kids, and therefore creating a niche market for Capretto might provide the producers with a specialized market and an additional income.

Further economic market studies are required to determine the feasibility and acceptance of such white kids meat. However in this research, we show strong evidence for the Capretto management as a good investment for salvaging weak twin Baladi goats, safeguarding Lebanese forests and natural grazing grounds from overgrazing, as well as providing a profitable return for farmers in remote areas of Lebanon.

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