Effect of Age and Body Condition on Slaughter Characteristics of Dromedary Camels (*Camelus dromedarius) in Eastern Ethiopia*

- Introduction
- Ethiopia has 4.5 million heads of dromedary camels (*Camelus dromedarius) (Shapiro et al., 2015)*
- *It is highly concentrated in the eastern part of the country (Yohannes et al., 2012).*

- Camels are the most important animals, resilient, multiple functions, highly productive than any other livestock species reared under pastoral systems in that challenging and too hostile environment.
- Simply they able to withstand this harsh condition because of their unique features of anatomic, physiological, physical and behavioral attributes.

- Camel are reared under extensive systems on poor levels of nutrition

- Camels are mostly slaughtered at old ages after completing a career in physical work, transportation and milk production (Kadim et al., 2013).

- the stock is basically kept for replacement and play multipurpose roles in the community.
- Meat production even though is not the main product derived from camels, but it is an important component product coming from camel under extensive management systems.

- The meat actually comprises of carcass and non-carcass characteristics which are affected by different factors such as age, body condition of the animal, breed, sex, fatness, dressing procedures, and degree of gut fill at slaughter

- However, there is little information on the effect of these factors on the carcass an d none carcass characteristics of camel particularly in Dire-Dawa area.
- Thus, this study was carried out to fill up the gap of knowledge with the following objectives.

- Objectives
- The objective of this study was to investigate the effects of age and body condition on carcass and non-carcass characteristics of camels slaughtered in Dire Dawa abattoir

Materials and Methods

- **Materials and Methods**
- The study was carried out in Dire Dawa town municipality abattoir, eastern Ethiopia where camels slaughtered catering for domestic consumption.

Materials and Methods…..

- Two factors (age & body condition) were considered in the study:
- The age of the camels i.e. the camels were grouped based on age into three categories
- 1” (6-10 years),
- “group II” (11-17 years), and
- “group III” (? 18 years); and, three body condition groups
- (poor, medium, and good)

Materials and Methods….. Materials and Methods…..

- The 2 factors each with 3 levels were arranged in a 3 × 3 two-way factorial Completely Randomized design Factorial (CRBD).

Materials and Methods…..

- ***Age estimation and assessment of body condition score***
- According to the abattoir's routine practices, camels were deprived of water and feed for from 24 and 12 hours at the awaiting area locally called Jellaba, after which they were taken to the abattoir for slaughter

- Scores of 1 to 5 (1 = very lean, 2 = below average, 3 = average or ideal, 4 = above average, and 5 = very fat) have been adopted to assess BCS (Gaden, 2005).
- Notations of the fat status of spinous and transverse processes of vertebra, hollow of flank, and ribs (Faye et al., 2001);
- and measurements of hump height and chest depth (Gaden, 2005; MoARD, 2008) were used to score body condition.

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- The notations were performed by visual observation and manual palpation (Faye et al., 2001).

- The camels were categorized into three condition groups as „poor‟ (BCS of 1 to 2), „medium‟ (BCS of 3) and „good‟ (BCS of 4 to 5) (Robinson, 2010).

- ***Estimation of live body weight***
- The live body weight of camels was estimated from linear measurements of girth (chest and hump) and shoulder height using the formula described by Younan et al. (2012).
- This formula entailed that body weight (kg) is equal to SH × TG × HG × 50,

- Where SH is equal to shoulder height measured vertically from the ground to the tip of the scapula using a graduated stick of 2.5 m height with a movable bar at right angle,
- TG is equal to thoracic girth in meters using a tape around the body just behind the sternal pad, and
- HG is equal to hump girth in meters using a tape along the abdomen over the midpoint of the hump

- The linear measurements were taken early in the morning when the animals were starved for at least 12 hrs in the awaiting area so as to reduce measurement variability.

- ***Slaughtering procedure and yield measures***

- According to the abattoir's routine practices, camels were deprived of water and feed for from 24 and 12 hours at the awaiting area locally called Jellaba, after which they were taken to the abattoir for slaughter

- Camels were slaughtered following the routine slaughtering procedure of the abattoir under veterinary inspection.

- The slaughtering began by restraining the camel and have it in crouching position cutting the Achilles tendons, followed by cutting the base of the neck where major vessels are well exposed
- Following the slaughtering and complete bleeding, all the feet were severed at the knee and hock joints followed by a severing of the head and neck and skinning of the neck cut.

- Skinning or flaying began at the back in a crouching position and continued downwards on both sides to the belly.
- The flayed hide remained on the ground under the belly until dissection of all cuts was completed

- Following skinning, , internal organs (liver, lung, and heart etc.) and gastrointestinal tracts were removed, the hump fat, front leg to the shoulder tip, the loin, ribs, kidneys, backbone, tract brisket, tail, hind legs, and hide were dissected based on the traditional dissection procedures at the abattoir and butcheries.

- Dissecting required that the carcass be divided into forequarter and hindquarter between the 12th rib and 1st lumbar vertebrae.
- A hanging scale of 100 kg (Model NTA, Camry, China) was used to weigh all fresh carcass and non-carcass components to the nearest 0.1 kg.
- The entire carcass cuts were sorted out into the following measure cuts.

- The total non-carcass product yield (TNPY) comprised the edible non-carcass product yield (ENPY) and the inedible non-carcass product yield (INPY).

- The total consumable products yield (TCPY) was the sum of hot carcass weight (HCW) and ENPY.

- The total slaughter weight (TSW) was comprised of TCPY and INPY

- The dressing-out percentage (DOP) was subsequently computed as percentage of HCW to live body weight

- ***Statistical analysis***

- The experimental design was a two-way factorial in a complete randomized design (Factorial-CRD). The model of the study was:

Materials and Methods…..

- ***Statistical analysis***
- The experimental design was a two-way factorial in a complete randomized design (Factorial-CRD). The model of the study was:

$Y_{ijk} = \mu + A_i + B_j + (AB)_{ij} + E_{ijk}$, where

Y_{ijk} = the response variable

μ = overall mean

A_i = the ith age effect

B_j = the jth body condition effect

$(AB)_{ij}$ = the interaction between the ith age and j^{th} body condition

E_{ijk} = random error

- Data were subjected to analysis of variance (ANOVA) using the General Linear Model (GLM) procedure of SAS version 9.1 (SAS, 2008),

Results and Discussion

- ***Linear body measurements, live weights and dressing-out percentages***

- Mean values (± standard errors) of the estimated weights from linear body measurements, hot carcass yields, and dressing-out percentages (DOP) of slaughters camels are summarized in Table 2, below

Results and Discussion…

Table 2. Linear measurements (m), estimates of live weights and hot carcass weights (kg), and dressing-out percentages (%) of camels slaughtered at Dire Dawa abattoir

Variables	Linear Measurements			Live Weight (LW)	Hot Carcass Weight (HCW)	Dressing-out % (DOP)
	Shoulder Height (SH)	Thoracic Girth (TG)	Hump Girth (HG)			
Age group (A)						
Group 1	1.73±0.02^{b}	1.73±0.02^{b}	1.84±0.03^{b}	278.4±11^{b}	153.68±7.21^{b}	55±1.14^{a}
Group 2	1.80±0.01^{a}	1.88±0.02^{a}	2.02±0.02^{a}	343.2±8^{a}	193.93±5.03^{a}	56.1±0.7^{a}
Group 3	1.80±0.01^{a}	1.91±0.01^{a}	2.04±0.02^{a}	357.0±6.7^{a}	200.68±4.46^{a}	56.3±0.8^{a}
Body condition group (B)						
Poor	1.77±0.01^{a}	1.80±0.02^{b}	1.90±0.02^{b}	305.0±7.1^{b}	161.99±4.67^{c}	53.3±0.7^{b}
Medium	1.78±0.01^{a}	1.83±0.02^{b}	1.95±0.03^{b}	321.7±8.9^{b}	182.77±5.90^{b}	56.7±0.9^{a}
Good	1.78±0.01^{a}	1.89±0.02^{a}	2.05±0.03^{a}	352.0±8.75^{a}	203.51±5.79^{a}	57.9±0.9^{a}
A × B	ns	ns	ns	ns	ns	ns
Overall values						
Range	1.42-2	1.37-2.22	1.4-2.45	145.9-544	61.14-323.99	44.2-69.4
Mean±SE	1.79±0.01	1.86±0.01	1.99±0.02	334.7±5.28	186.4±3.56	55.5±0.5
CV	4.71	6.03	8.08	15.94	18.93	9.98

^{a,b,c} Means with the same letter superscripts in the same column for each treatment factor are not significantly different ($P<0.05$); group 1 (6-10 year-old), group 2 (11-17 year-old) and group 3 (≥ 18 year-old); ns = not significant.

Results and Discussion…

Table 3. Effect of age and body condition score on carcass and non-carcass weights (kg) of camels slaughtered at Dire Dawa abattoir.

Factors	Edible Components		Inedible Non-carcass Product Yield (INPY)	TCPY = HCW + ENPY	Total Slaughter Wt. (TSW) = TCPY + INPY
	Hot Carcass Weight (HCW)	Edible Non-carcass Product Yield (ENPY)			
Age group (A)					
Group 1	153.67±7.21[b]	24.08±0.92[b]	91.57±3.46[b]	177.75±7.99[b]	269.32±11.16[b]
Group 2	193.93±5.03[a]	29.49±0.64[a]	112.79±2.41[a]	223.42±5.58[a]	336.21±7.78[a]
Group 3	200.68±4.46[a]	31.13±0.57[a]	118.59±2.14[a]	231.81±4.94[a]	350.39±6.90[a]
Body condition group (B)					
Poor	161.99±4.67[c]	26.06±0.59[b]	101.30±2.24[b]	188.06±5.18[c]	289.36±7.23[c]
Medium	182.77±5.90[b]	28.30±0.75[a]	105.13±2.83[b]	211.08±6.55[b]	316.21±9.14[b]
Good	203.51±5.79[a]	30.33±0.74[a]	116.52±2.78[a]	233.84±6.42[a]	350.36±8.96[a]
A × B	ns	ns	ns	ns	ns
Overall values					
Range	61.14-323.99	10.64-41.21	52.25-181.59	71.78-362.74	126.37-544.33
Mean±SE	186.4±3.56	28.92±0.45	110.7±1.71	215.33±3.97	326.03±5.57
CV	18.93	15.51	15.30	18.18	16.76

[a,b,c] Means with the same letter superscripts in the same column for each treatment factor are not significantly different ($P<0.05$); TCPY = total consumable product yield; group 1 (6-10 year-old), group 2 (11-17 year-old) and group 3 (≥ 18 year-old); ns = not significant.

Results and Discussion…

- The major edible parts of the carcass were categorized into forequarter and hindquarter. The weight of each quarter significantly (*P<0.001) increased with age and improving body condition score of the camels. This may be due to an increase in physical and/or chemical maturity (Table 4).*

Results and Discussion…

Table 4. Mean (±standard error) weights (kg) of major carcass cuts of camels.

Major Cuts	Age group			Body condition group		
	Group 1	Group 2	Group 3	Poor	Medium	Good
Forequarter	77.32±4.3 b	96.88±3.1 a	103.09±2.7 a	81.12±3^{c}	92.77±3.6 b	104.65±3.6 a
Neck	13.9±0.9^{b}	18.7±0.6^{a}	20.1±0.6^{a}	16.4±0.6^{b}	17.5±0.7^{ab}	19±0.7^{a}
Front legs	42.6±2.2^{b}	53.3±1.5^{a}	55.4±1.3^{a}	44.7±1.4^{c}	50.3±1.8^{b}	56.4±1.7^{a}
Hump	3.8±0.6^{b}	5.6±0.4^{a}	4.3±0.4^{b}	2.8±0.4^{c}	4.5±0.5^{b}	6.35±0.5^{a}
Ribs	8.18±0.5^{b}	8.98±0.3^{a}	10.29±0.3^{a}	8.31±0.3^{b}	9.67±0.4^{a}	10.5±0.4^{a}
Brisket	8.84±0.5^{b}	11.6±0.4^{a}	11.7±0.3^{a}	8.91±0.3^{c}	10.8±0.4^{b}	12.4±0.4^{a}
Hindquarter	61.22±3.1 b	76.02±2.3 a	80.11±1.9^{a}	64.72±2.2 b	72.64±2.6 b	79.96±2.6^{a}
Hind legs	42±1.9^{b}	51.5±1.3^{a}	54.5±1.2^{a}	44.5±1.2^{c}	49.5±1.6^{b}	54±1.5^{a}
Loin	14.2±0.7^{b}	18.4±0.5^{a}	19.3±0.5^{a}	15.2±0.5^{c}	17.2±0.6^{b}	19.5±0.6^{a}
Flank	5.02±0.3^{b}	6.12±0.2^{a}	6.31±0.2^{a}	5.09±0.2^{b}	5.93±0.2^{a}	6.46±0.2^{a}

^{a,b,c} Means with the same letter superscripts in the same row under each treatment factor are not significantly different ($P<0.05$); group 1 (6-10 year-old), group 2 (11-17 year-old) and group 3 (≥ 18 year-old).

Results and Discussion…

- Age and body condition of the camels had a significant effect on most of the ENPY and INPY components with higher values obtained with increases in age and towards good body condition of camels (Table 5)

Results and Discussion…

Table 5. Mean (± standard error) weight (kg) of major edible and inedible non-carcass components.

Non-carcass Components	Age group			Body condition group		
	Group 1	Group 2	Group 3	Poor	Medium	Good
Edible	21.21±0.8[c]	25.9±0.6[b]	27.24±0.5[a]	22.8±0.6[b]	24.88±0.7[ab]	26.59±0.7[a]
Liver	5.2±0.3[b]	6.1±0.2[a]	6.4±0.2[a]	5.3±0.2[b]	6.1±0.3[a]	6.3±0.3[a]
Heart	1.8±0.1[a]	2±0.09[a]	2±0.08[a]	1.8±0.08[a]	2±0.1[a]	2±0.1[a]
Stomach	5.35±0.3[b]	6.64±0.2[a]	6.69±0.2[a]	5.82±0.2[b]	6.18±0.2[ab]	6.69±0.2[a]
Head	8.76±0.4[c]	11.16±0.3[b]	12.15±0.3[a]	9.9±0.3[b]	10.6±0.4[b]	11.6±0.4[a]
Inedible	91.47±3.5[b]	112.78±2.5[a]	118.62±2.2[a]	82.51±2.4[b]	86.12±2.9[b]	95.95±2.9[a]
Feet	12±0.6[b]	14.8±0.4[a]	15.6±0.4[a]	13.4±0.4[b]	13.7±0.5[b]	15.3±0.5[a]
Lung	1.8±0.13[a]	1.8±0.09[a]	2±0.08[a]	1.84±0.1[a]	1.88±0.1[a]	1.94±0.1[a]
Hide	23.5±1.2[b]	30.2±0.8[a]	32±0.74[a]	26.3±0.8[b]	27.8±1[b]	31.7±0.9[a]
Spleen	0.53±0.03[b]	0.68±0.02[a]	0.7±0.02[a]	0.57±0.02[c]	0.64±0.02[b]	0.71±0.02[a]
Intestine	16.9±1[b]	19.8±0.7[a]	21±0.6[a]	18.5±0.8[a]	18.9±0.6[a]	20.4±0.8[a]
Blood	20.05±0.8[b]	24.7±0.5[a]	25.7±0.5[a]	21.9±0.5[b]	23.2±0.6[b]	25.3±0.6[a]
Rep. organ	0.39±0.02[b]	0.5±0.01[a]	0.52±0.01[a]	0.42±0.01[c]	0.48±0.02[b]	0.53±0.02[a]
Misc.	16.3±0.63[b]	20.3±0.44[a]	21.06±0.4[a]	17.96±0.4[b]	18.9±0.5[b]	20.7±0.5[a]

[a,b,c] Means with the same letter superscripts in the same row under each treatment factor are not significantly different ($P<0.05$); group 1 (6-10 year-old), group 2 (11-17 year-old) and group 3 (≥ 18 year-old).

Conclusion

- Camels, even under the extensive system, can be used to supply high quality protein to a large human population. (45-63 % for cattle 55% for camel)
- Body weight and weight of carcass and non-carcass components were affected by the age and the body condition score of the camels.
- Live and slaughter weights of camels significantly increased with the increasing age of the animal.
- These parameters also increased with improving body conditions of camels in the same age group.

Conclusion…

- For many of the variables, camels at 11-17 and ≥ 18 year-old, and those at medium and good body condition scores had comparable values in their respective groups.