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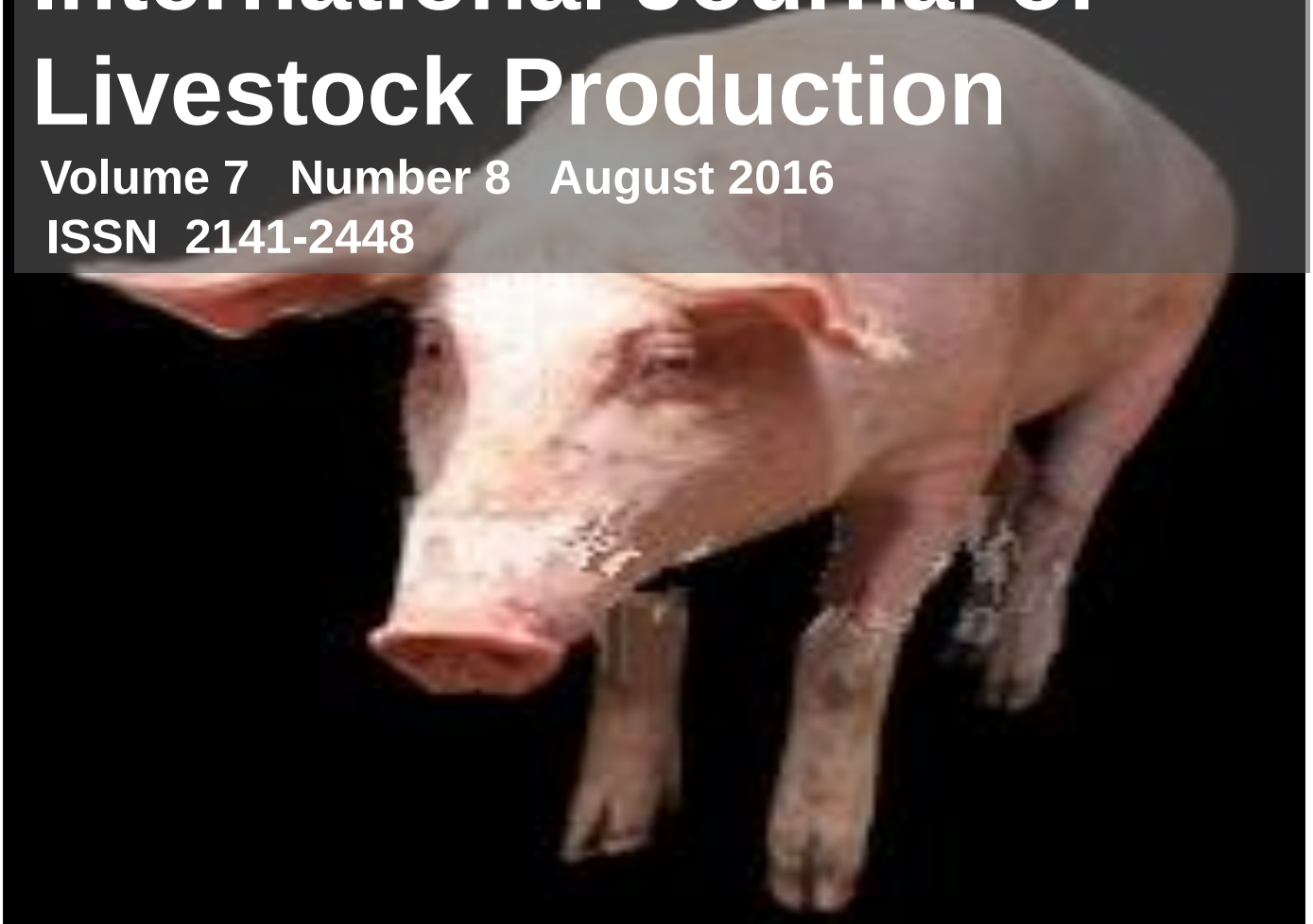

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Full Length Research Paper

Effects of pre-weaning feed supplementation and total versus fenceline weaning on the physiology and performance of beef steers

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Forty-eight Angus steers (208 ±15 days of age) housed on pasture with their dams, were divided equally based on initial body weight (BW; 312 ± 28 kg), and assigned randomly to assess whether receiving a palatable, high fiber supplement (YS; 4.5 kg/cow-calf/day) versus no supplement (NS) for 7 days prior to weaning alters the steers' acute stress response following separation from its dam. Steers were weaned (day 0) by fenceline (FS; 12 NS and 12 YS) or total separation (TS; 12 NS and 12 YS). On day 7 the FS group was moved to a pasture lot distant from their dams and adjoining the TS group. All steers were weighed and bled on days -7, 0, 3, 7, 14, and 35 (BW only) and provided access to the supplement on days 0 to 14. By day 0, BW gain increased (P<0.01) and serum interferon-γ (IFN-γ) concentration decreased (P<0.01) in all steers. However, the YS steers exhibited greater (P<0.05) neutrophil to lymphocyte (N:L) ratio and total plasma cortisol (CORT; P=0.09) and ceruloplasmin (CER; P=0.08) concentrations compared with NS steers. From weaning to day 7, NS-TS steers initially experienced a BW loss (P<0.01) followed by a BW gain (P<0.01) when compared with the remaining steers. At 3 day post-weaning, mean hematocrit for YS steers was lower (P < 0.01) than that of NS steers and CORT was greater (P<0.05) for NS-TS vs. YS-TS steers. Red blood cell number, N:L ratio, haptoglobin and IFN-γ concentrations increased (P<0.01) in all steers by day 3 and returned to pre-weaning concentrations thereafter. From days 14 to 35, NS-FS steers gained less (P<0.01) weight compared with YS-FS and all TS steers. These results suggest that providing a high fiber supplement beginning from 7 days prior to weaning may reduce BW loss and temper the steers' acute stress response when weaned using total separation.

Key words: Beef steers, pre-weaning supplementation, stress.

INTRODUCTION

Strategies incorporating a pre-weaning/pre-conditioning program have been investigated and employed with the overall objective of reducing the stress associated with breaking the cow-calf bond. The program may involve providing solid food to calves prior to weaning in an effort to prepare them for receiving at the feedlot (Arthington et al., 2008). Also, a health program is conducted where a range of vaccines are given.

As a consequence, pre-conditioned calves have a lower incidence of morbidity and mortality, gain body weight (BW) faster and reach market weight earlier than those not pre-conditioned (Roeber et al., 2001; Bailey and Stenquist, 1996; Hilton, 2015).

Stress associated with weaning of beef calves has been shown to elicit an acute increase in circulating levels of various blood constituents including cortisol (Lefcourt and Elsasser, 1995; Hickey et al., 2003), the cytokine interferon-γ (Carroll et al., 2009), and the acute phase proteins ceruloplasmin and haptoglobin (Arthington et al., 2003; Qiu et al., 2007) to name a few. Alterations in blood constituents such as these can be attributed to weaning method and degree of separation as well (Hickey et al., 2003; Campistol et al., 2013). The objective of this study was to examine performance and physiological responses in beef steer calves provided there is a palatable high fiber supplement for 7 days prior to weaning, and weaned with or without temporary fenceline contact with their dams. The hypothesis of this experiment was that a 1-week supplementation of the cow-calf pair with the palatable diet would be sufficient time to familiarize the calf to subsequent offering following weaning, thus reducing the acute stress response experienced by the calf following two different methods of separation from its dam.

MATERIALS AND METHODS

Animals and experimental design

All animal procedures were reviewed and approved by the University of Tennessee Animal Care and Use Committee prior to the initiation of this experiment. Forty-eight Angus steer calves (initial BW 312 ± 28 kg; 208 ± 15 days of age (mean ± SD), born and maintained with their dams on an established pasture of mixed orchardgrass (*Dactylis glomerata*) and tall fescue (*Festuca arundinacia*), were used in this study. Steers were initially vaccinated at 138 ± 15 days of age with Cattlemaster® 5 (Pfizer Animal Health, Exton, PA) and Vision® 7 (Intervet Inc., Millsboro, DE), implanted with Ralgro® (Schering-Plough Animal Health Corp., Summit, NJ), and de-wormed with the pour-on Dectomax® (Pfizer Animal Health, Exton, PA), and revaccinated with Cattlemaster® 5 and Vision® 7 at 174 ± 15 days of age.

Steers were equalized by initial BW on day-14 to two groups. Blood samples were collected and additional BW were recorded between 800 and 1000 h, 7 days (day -7) prior to weaning (day 0) and on days 3, 7, 14, and 35 (BW only) post-weaning. Beginning on day -7, steers and their dams (n=24) were offered as a group a high fiber supplement in well-spaced troughs at 4.5 kg/cow-calf pair/day (YS). Ingredient composition of the supplement is presented in Table 1. The remaining steers with their dams served as controls and were not supplemented (NS). All steers were provided the same supplement from weaning to day 14. On day of weaning, 24 steers (12 YS and 12 NS) were randomly selected and moved to a0.81 ha pasture lot adjacent to their dams separated by woven-wire fence with openings too small to accommodate a calf's head (fenceline separation; FS). The remaining steers were separated from their dams and transported to a distant pasture lot such that the vocalizations of either group could not be heard by the other (total separation; TS). On day 7 following weighing and bleeding, the FS group was transported to a pasture lot adjoining the TS group.

Table 1. Composition and nutrient content of high fiber supplement fed to cow-calf pairs.

Composition	% (As-fed basis)
Cracked corn grain	23.0
Soyhulls (Pelleted)	10.0
Soybean meal	3.3
Cottonseed meal	10.4
Cane Molasses	5.0
TM salt	0.3
Citrus Pulp (Pelleted)	20.0
Cottonseed hulls	28.0

Nutrient content	% (Dry Matter basis)
TDN	71.79
CP	12.66
Ca	0.59
P	0.28
K	1.17
CF	22.67

Blood sample collection and analyses

Blood samples were obtained via jugular venipuncture from each steer while restrained in a squeeze chute with head gate. Each blood sample was collected into two 10.0 ml vacutainer tubes with and without lithium heparin (Cat. No. 02-689-7, 02-683-60; Fisher Scientific, Sewanee, GA). Blood smears were made from heparinized whole blood for hematological analyses. Plasma was collected from heparinized blood following centrifugation at 2,000 × *g* for 20 min at 4°C, aliquoted into three 1.8 ml cryogenic vials, and stored at -20°C until analyzed for total cortisol, haptoglobin and ceruloplasmin. The non-heparinized blood was refrigerated overnight at 4°C, centrifuged, and serum was harvested and stored at -20°C until analyzed for interferon-γ (IFN-γ).

Blood smears were prepared on glass slides and stained with hema-quick stain solution (Hema 3 Stat Pack Cat # 123-869; Fisher Scientific, Sewanee, GA, USA). Smears were examined under oil immersion (100 ×) to differentiate the number of neutrophils and lymphocytes within 100 cells counted, and subsequent calculation of neutrophil to lymphocyte (N:L) ratio. Hematocrit (HCT) values were recorded at each sampling time. Red blood cell (RBC) and white blood cell (WBC) counts were determined (ABC Counter, Grayslake, IL, USA). Plasma total cortisol concentration was analyzed using an RIA procedure (Coat-A-Count, Diagnostic

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Products, Los Angeles, CA, USA) as previously reported in our laboratory (Doherty et al., 2007). Intra- and inter-assay coefficient of variation (CV) were 5.7 and 14.7% for low (14.0 ng/ml) and 11.8 and 9.0% for high (54.1 ng/ml) cortisol standards, respectively.

Plasma haptoglobin concentration was determined in duplicate samples by measuring haptoglobin/hemoglobin complexing by the estimation of differences in peroxidase activity and read in units of absorption × 100 at 450 nanometer (Makimura and Suzuki, 1982) following assay quality controls as described by Qiu et al. (2007). Intra- and inter-assay CV for haptoglobin were 1.7 and 1.9%, respectively. Plasma ceruloplasmin oxidase activity was analyzed using colorimetric procedures as described by Demetriou et al. (1974). Concentrations were expressed as milligrams per deciliter. Intra- and inter-assay CV for ceruloplasmin were 1.6 and 4.8%, respectively. Serum IFN-γ was assayed per the manufacturer's protocol using a custom-developed multiplex ELISA validated for bovine cytokines (SearchLight, Pierce Biotechnology Inc., Rockford, IL, USA) as reported previously (Carroll et al., 2009) with a detection range of 2.0 to 500 pg/ml. Intra- and inter-assay CV were 11.1 and 8.4%, respectively.

Statistical analysis

Data were analyzed using the MIXED procedure (SAS Institute Inc., Cary, NC, USA) for a completely randomized design with BW at birth and age used as covariates. Calves were initially stratified by BW and then randomly assigned to treatments within strata. The pre-weaning statistical model included supplement with calf as the experimental unit, and repeated measures for data collected on days -7 and 0. The post-weaning model included a supplement by separation factorial with calf as the experimental unit, and repeated measures for data collected on days 0, 3, 7, 14, and 35. Autoregressive correlation was used for repeated measures, and denominator degrees of freedom were adjusted using Kenward-Roger. Least squares means with standard error (SEM) were reported, with Fisher's protected least significant difference mean separation at the 5% significance level. Statistical trends were considered when $0.05 < P < 0.10$. Data were examined for normality (Shapiro-Wilk), extreme observations and equality of variance.

RESULTS AND DISCUSSION

Steer BW and physiological response measurements during the pre- and post-weaning treatment periods are provided in Tables 2 and 3, respectively. The BW gain was not different (P=0.31) between the YS and NS steers over the 7 days prior to separation from their dams (Table 2). Arthington et al. (2008) similarly reported minimal differences in BW gain between creep-fed steer calves provided free-choice access to a concentrate supplement for 45 to 53 days when compared with non-supplemented calves and suggested that this was the result of the limited time of creep feeding. From weaning to day 7, steers not receiving the pre-weaning supplement and total separation (NS-TS) initially experienced a weight loss ($P < 0.01$) followed by a compensatory weight gain ($P < 0.01$) when compared with the remaining steers (Table 3). Price et al. (2003) likewise reported lower weight gain in non-conditioned heifer calves on pasture at 2 and 10 weeks following total separation compared with fenceline separated calves. They also found that preconditioning calves with hay for 10 days prior to weaning in drylots did not improve weight gain following weaning. Weight gain was not different ($P > 0.10$) among steers on days 7 to 14 regardless of dietary supplementation or method of weaning. From days 14 to 35, NS-FS steers gained less ($P < 0.01$) weight compared with YS-FS and all TS steers. Although not statistically different, the mean overall BW gain during post-weaning (days 0 to 35) was numerically greater for YS-TS compared with NS-TS steers.

The hypothesis of this experiment was that a 1-week supplementation of the cow-calf pair with a palatable diet would be sufficient time to familiarize the calf to subsequent offering following weaning, thus reducing the acute stress response experienced by the calf following separation from its dam. We found that 11 of the 12 steers within the NS-TS group experienced acute weight loss over the 3 days following weaning resulting in an overall 5 week post-weaning BW of 11.4 kg less than their supplemented counterpart. Since actual feed consumption was neither measured nor observed in our study due to grazing in the pasture, we can only speculate that by not having prior exposure to the supplement, the steers may have been reluctant to consume it upon weaning since this was their first exposure to the supplement. Price et al. (2003) reported that calves preconditioned to hay spent a greater percentage of their time eating than non-preconditioned calves (28.9 vs. 21.5%) during the first 3 days after being weaned to drylots.

The HCT of steers did not differ between treatments prior to weaning (Table 2). On day 3, the mean HCT for NS steers was higher ($P < 0.01$) than that for YS steers (38.4 vs. 35.5%; SEM = 0.5; Table 3). All steers had similar but lower ($P < 0.01$) HCT on day 14 compared to day 7 (35.0 vs. 37.9%; SEM = 0.4). No treatment effects were found for RBC count in steers over the sampling times (Tables 2 and 3). The RBC count increased ($P < 0.01$) in all steers from days 0 to 3 (6.9 and 8.0 x 10^6/µl, respectively; SEM = 0.1) and returned to pre-weaning values by day 7. Thus, the elevated HCT for the NS steers does not appear to be a result of polycythemia but may be a sign of dehydration, which has been shown to occur in calves in response to long-distance road transport (Bernardini et al., 2012) and elevated cortisol levels (Parker et al., 2004). Water intake in growing beef cattle was found to be positively correlated with BW gain (Brew et al., 2011), and as noted before, steers in the NS-TS treatment did indeed experience acute weight loss upon weaning. Both weight loss and reduced water intake could be a consequence of this latter treatment group not having previous exposure to the novel diet compounded by the stress of total separation from their dams.

A time × diet interaction was detected for plasma cortisol concentrations, such that cortisol measured on day 0 tended (P=0.09) to be greater in YS than in NS

Table 2. Effects of a fiber supplement on growth performance and physiological responses of pre-weaned beef steers.

Item[1]	Day	Supplement[2]	No Supplement[3]	SEM[4]
Steers, no.	-	24	24	-
Initial BW, kg	-7	319	315	4.2
Total gain, kg	-7 to 0	6.2	7.7	1.0
HCT, %	-7	37.2	37.7	0.7
	0	36.1	37.5	0.6
RBC, × 10^6/µl	-7	7.4	7.7	0.1
	0	7.1	6.7	0.2
WBC, × 10^3/µl	-7	10.1	12.1	0.8
	0	10.4	11.6	0.8
N:L	-7	0.23	0.25	0.03
	0	0.27[a]	0.16[b]	0.03
Cortisol, ng/ml	-7	25.5	21.6	2.0
	0	35.9[c]	26.8[d]	2.9
Haptoglobin, OD × 100	-7	6.0	6.0	0.1
	0	6.0	6.0	0.1
Ceruloplasmin, mg/dl	-7	25.0	24.2	1.0
	0	27.3[c]	22.0[d]	1.8
IFN-γ, pg/dl	-7	10.3	8.8	1.5
	0	6.1	6.1	1.0

[a,b]Within a row, means without common superscripts differ (P<0.05).[c,d]Within a row, means without common superscripts differ (P<0.10). [1]HCT = hematocrit; RBC = red blood cell; WBC = white blood cell; N:L = neutrophil to lymphocyte ratio; OD = optical density; IFN-γ = interferon-γ.[2]Steers provided a fiber supplement beginning 7 days prior to weaning (day 0). [3]Steers not provided a fiber supplement prior to weaning.[4]Standard error of mean.

Table 3. Effects of a fiber supplement on growth performance and physiological responses of post-weaned beef steers.

Item[1]	Day	Supplement[2]		No Supplement[3]		SEM[5]
		Fenceline[4]	Total	Fenceline	Total	
Steers, no.	-	12	12	12	12	-
Initial BW, kg	0	321	322	321	325	7
Gain, kg	0 to 3	0.2[a]	5.8[a]	3.4[a]	-16.0[b]	2.3
	3 to 7	3.0[a]	4.4[a]	5.9[a]	14.1[b]	2.5
	7 to 14	1.0	6.0	7.4	1.5	2.9
	14 to 35	18.0[a]	13.2[a]	5.5[b]	18.9[a]	2.5
Total gain, kg	0 to 35	21.8	29.5	22.9	18.1	3.7

Table 3. Contd.

HCT, %	0	35.9	36.3	37.6	37.4	0.8
	3	35.7[a]	35.3[a]	38.6[b]	38.2[b]	0.8
	7	36.8	37.7	39.5	37.6	0.8
	14	35.1	35.5	34.8	34.8	0.9
RBC, × 10^6/µl	0	7.2	6.9	6.7	6.6	0.3
	3	8.0	7.6	8.3	8.2	0.3
	7	6.8	7.5	7.4	7.1	0.3
	14	7.1	7.0	7.3	7.4	0.2
WBC, × 10^3/µl	0	10.5	10.3	11.7	11.5	1.2
	3	12.9	11.1	12.9	11.6	1.0
	7	13.9	10.4	19.5	13.6	1.9
	14	13.3	12.2	18.4	14.6	3.0
N:L	0	0.30	0.24	0.17	0.14	0.04
	3	0.39	0.32	0.45	0.37	0.06
	7	0.33	0.34	0.32	0.25	0.03
	14	0.24	0.18	0.28	0.40	0.06
Cortisol, ng/ml	0	39.4	32.0	28.9	25.1	3.6
	3	24.2[cd]	22.8[c]	25.2[cd]	34.2[d]	4.2
	7	27.6	21.4	25.2	28.7	4.0
	14	28.2	16.2	16.2	21.7	3.1
Haptoglobin, OD × 100	0	5.8	6.2	5.8	6.1	0.1
	3	6.5	6.2	6.8	6.4	0.3
	7	6.1	6.0	6.0	6.0	0.1
	14	5.6	5.8	6.0	5.7	0.1
Ceruloplasmin, mg/dl	0	28.8	25.9	23.4	20.7	2.7
	3	27.8	25.3	25.8	25.7	1.6
	7	27.0	25.4	25.9	25.8	1.6
	14	24.3	21.5	25.7	21.5	1.7
IFN-γ, pg/dl	0	7.1	5.2	5.4	6.9	1.4
	3	11.3	7.4	10.0	6.9	1.6
	7	6.3	5.1	6.7	5.3	1.3
	14	18.6	11.3	11.9	8.5	2.7

[a,b]Within a row, means without common superscripts differ (P<0.01).[c,d]Within a row, means without common superscripts differ (P<0.05).[1]HCT = hematocrit; RBC = red blood cell; WBC = white blood cell; N:L = neutrophil to lymphocyte ratio; OD = optical density; IFN-γ = interferon-γ.[2]Steers provided a fiber supplement beginning 7 days prior to weaning (day 0). [3]Steers not provided a fiber supplement prior to weaning.[4]Steers within pre-weaning treatment were separated from their dams by fenceline contact on days 0 to 7 followed by relocation to a distant pasture (total), or total alone.[5]Standard error of mean.

steers (Table 2). Feeding activity among the calves and their dams for access to the supplement may have contributed to this elevation in cortisol. Following separation (day 3), the NS-TS steers had greater (P<0.05) plasma cortisol concentration than the YS-TS steers (Table 3). In that the non-supplemented, total separated steers experienced weight loss and possibly dehydration, we contend this increase in cortisol was related to the abrupt separation from their dam and not exposure to the novel feed supplement. Parker et al. (2004) showed that excess cortisol has a suppressive effect on the renin-angiotensin-aldosterone axis in *Bos Indicus* steers, which would interfere with their ability to resist dehydration. Except for the YS-FS treatment group,

the remaining steers exhibited a decline in cortisol concentration from days 7 to 14.

The overall pre-weaning WBC count tended (P=0.06) to be greater in NS compared with YS steers (11.8 vs. 10.3 × 10^3 cells/µl; SEM = 0.6; Table 2). Following weaning, FS steers exhibited overall greater (P < 0.05) WBC count compared with that measured for the TS steers (14.0 vs. 11.7 × 10^3 cells/µl; SEM = 0.6; Table 3). All steers exhibited greater (P < 0.05) WBC counts on days 7 and 14 compared with day 0 (14.0 and 14.5 vs. 11.0 × 10^3 cells/µl, respectively; pooled SEM = 0.9). Regarding changes in differential WBC populations, lymphocyte percentage was greater (P < 0.05) and neutrophil percentage was lower (P < 0.05) on day 0 in NS vs. YS steers (data not shown) resulting in a lower (P < 0.05) N:L ratio for the NS steers (Table 2). From days 0 to 3, all steers experienced a decrease (P < 0.01) in lymphocyte percentage and an increase (P < 0.01) in neutrophil percentage (data not shown) resulting in an increase (P < 0.01) in the N:L ratio from 0.21 to 0.38 (Table 3). This result is consistent with that noted in previous studies as to that the impact weaning stress has on WBC populations in cattle (Hickey et al., 2003; Lynch et al., 2010a,b; Lynch et al., 2012; Campistol et al., 2013). Indeed, the higher neutrophil percentage observed on day 0 in the YS steers is concurrent with the elevated cortisol concentration as noted.

Haptoglobin concentrations did not differ between treatment groups either during the pre- or post-weaning sampling periods (Tables 2 and 3). Overall, haptoglobin concentration measured on day 3 was greater (P < 0.01) than on other days sampled (6.6 vs. 6.0 absorption × 100 at 450 nm; SEM = 0.1). In an earlier study, Lynch et al. (2012) also reported a significant increase in haptoglobin concentration on day 2 following weaning, which was not different between calves having received a concentrate supplement for 26 days prior to weaning compared with non-supplemented calves. On day 0, plasma ceruloplasmin tended (P=0.08) to be greater for YS steers than NS steers (Table 2). As noted, the YS steers sampled on day 0 also had significantly higher cortisol concentrations and higher neutrophil percentage, which resulted in a greater N:L ratio compared with the NS steers. Together, these findings are in agreement with those reported previously indicating a positive relationship between these blood constituents and an acute phase stress response (Cooke and Bohnert, 2011; Campistol et al., 2013; O'Loughlin et al., 2014). Ceruloplasmin concentrations were not different among treatment groups at any time after weaning (Table 3). However, the mean concentrations measured on days 3 and 7 were greater (P < 0.01) than that measured on day 14 (26.1 and 26.0 vs. 23.2 mg/dl; pooled SEM = 0.9). Serum concentrations of IFN-γ did not differ (P = 0.53) as a result of pre- or post-weaning treatment. All steers experienced a decrease (P < 0.01) in IFN-γ from days -7 to 0 (9.5 vs. 6.1 pg/dl; SEM = 0.9; Table 2), which then increased (P < 0.01) by day 3 (8.7 pg/dl; SEM = 0.8; Table 3). The mean IFN-γ concentration returned to pre-weaning concentrations by day 7 but then increased (P<0.01) to their highest concentrations on day 14 (5.8 vs. 12.1 pg/dl; pooled SEM = 0.9).

Collectively, the pre-weaning increase in N:L ratio and plasma cortisol and ceruloplasmin concentrations in the YS steers may indeed be a reflection of increased activity due to competition for the feed supplement. In general, all steers exhibited changes in the growth and physiological indices measured in this study consistent with that associated with acute weaning stress as reported previously (Campistol et al., 2013). However, the results of the present study suggest that providing a high fiber supplement beginning 7 days prior to weaning may reduce body weight loss and temper the steers' acute stress response when weaned using total separation from their dam.

Conflict of interest

The authors have not declared any conflict of interest

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REFERENCES

Arthington JD, Eicher SD, Kunkle WE, Martin FG (2003). Effect of

transportation and commingling on the acute-phase protein response, growth, and feed intake of newly weaned beef calves. J. Anim. Sci. 81:1120-1125.
Arthington JD, Qiu X, Cooke RF, Vendramini JMB, Araujo DB, Chase Jr. CC, Coleman SW (2008). Effects of preshipping management on measures of stress and performance of beef steers during feedlot receiving. J. Anim. Sci. 86:2016-2023.
Bailey D, Stenquist NJ (1996). Preconditioning calves for feedlots: Managing for today's cattle market and beyond. Accessed July 1, 2013. Available at: http://marketing.uwagec.org/MngTCMkt/Precond.pdf
Bernardini D, Gerardi G, Peli A, Costa LN, Amadori M, Segato S (2012). The effects of different environmental conditions on thermoregulation and clinical and hematological variables in long-distance road-transported calves. J. Anim. Sci. 90:1183-1191.
Brew MN, Myer RO, Hersom MJ, Carter JN, Elzo MA, Hansen GR, Riley DG (2011). Water intake and factors affecting water intake of growing beef cattle. Livest. Sci. 140:297-300.
Campistol C, Kattesh HG, Waller JC, Rawls EL Arthington JD, Engle TE, Carroll JA, Pighetti GM, Saxton AM (2013). Effects of two-stage and total vs. fenceline weaning on the physiology and performance of beef steers. J. Anim. Sci. 29:501-507.
Carroll JA, Arthington JD, Chase Jr. CC (2009). Early weaning alters the acute-phase reaction to an endotoxin challenge in beef calves. J. Anim. Sci. 87:4167-4172.
Cooke RF, Bohnert DW (2011). Technical note: Bovine acute-phase response after corticotrophin- release hormone challenge. J. Anim. Sci. 89:252-257.
Demetriou JA, Drewes PA, Gin JB (1974). Ceruloplasmin. Pages 857-864 in Clinical Chemistry. Cannon DC, Winkelman JW, ed. Harper and Row, Hagerstown, MD USA.
Doherty TJ, Kattesh HG, Adcock RJ, Welborn MG, Saxton AM, Morrow JL, Dailey JW (2007). Effects of a concentrated lidocaine solution on the acute phase stress response to dehorning in dairy calves. J. Dairy Sci. 90:4232-4239.
Hickey MC, Drennan M, Earley B (2003). The effect of abrupt weaning of suckler calves on the plasma concentrations of cortisol, catecholamines, leukocytes, acute-phase proteins and in vitro interferon-gamma production. J. Anim. Sci. 81:2847-2855.
Hilton WM (2015). Management of preconditioned calves and impacts of preconditioning. Vet. Clin. Food Anim. 31:197-207.
Lefcourt AM, Elsasser TH (1995). Adrenal responses of Angus x Hereford cattle to the stress of weaning. J. Anim. Sci. 73:2669-2676.
Lynch EM, Earley B, McGee M, Doyle S (2010a). Characterization of physiological and immunological responses in beef cows to abrupt weaning and subsequent housing. BMC Vet. Res. 6:37.
Lynch EM, Earley B, McGee M, Doyle S (2010b). Effect of abrupt weaning at housing on leukocyte distribution, functional activity of neutrophils, and acute phase protein response of beef calves. BMC Vet. Res. 6:39.
Lynch EM, McGee M, Doyle S, Earley B (2012). Effect of pre-weaning concentrate supplementation on peripheral distribution of leukocytes, functional activity of neutrophils, acute phase protein and behavioural responses of abruptly weaned and housed beef calves. BMC Vet. Res. 8:1.
Makimura S, Suzuki N (1982). Quantitative determination of bovine serum haptoglobin and its elevation in some inflammatory disease. The Jap. J. Vet. Sci. 44:15-21.
O'Loughlin A, McGee M, Doyle S, Earley B (2014). Biomarker responses to weaning stress in beef calves. Res. Vet. Sci. 97:459-464.
Parker AJ, Hamlin GP, Coleman CJ, Fitzpatrick LA (2004). Excess cortisol interferes with a principal mechanism of resistance to dehydration in *Bos indicus* steers. J. Anim. Sci. 82:1037-1045.
Price EO, Harris JE, Borgwardt RE, Sween ML, Connor JM (2003). Fenceline contact of beef calves with their dams at weaning reduces the negative effects of separation on behavior and growth rate. J. Anim. Sci. 81:116-121.
Qiu X, Arthington JD, Riley DG, Chase Jr. CC, Phillips WA, Coleman SW, Olson TA (2007). Genetic effects on acute phase protein response to the stresses of weaning and transportation in beef calves. J. Anim. Sci. 85:2367-2374.
Roeber DL, Speer NC, Gentry JG, Tatum JD, Smith CD, Whittier JC, Jones GF, Belk KE, Smith GC (2001). Feeder cattle health management: Effects on morbidity rates, feedlot performance, carcass characteristics, and beef palatability. Prof. Anim. Sci. 17:39-44.

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Study on cattle management and marketing practices in Afar region

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This study attempted to assess cattle management and marketing practices in Afar region. 178 household heads were selected and interviewed from three major cattle producing districts, Aysaita, Chifra and Amibara. With an overall average cattle holding of 17.4 heads per household, cattle were kept by 95.5% of the herd owners mainly for milk production. Livestock sale, land rent and crop sale were the first, second and third major income sources for cattle owners of the study area, with index values of 0.455, 0.287 and 0.209, respectively. The major feed resource for livestock in the study area was natural pasture grazing (97.8%). 72.1% of the respondents used rivers as the main water sources for their cattle. 68.7% of the cattle owners sold male cattle at younger age; and 61.5% of them sold female cattle at older age. Most (70.4%) of the producers responded that middlemen were the major buyers of their cattle in the study districts. Feed shortage, diseases and drought were ranked as first, second and third major cattle production constraints, with an index value of 0.418, 0.193 and 0.178, respectively. 40.8% of the respondents stated dry season as the main season of feed shortage. The major prevalent diseases in the three districts were lumpy skin disease, sudden death and pneumonia that ranked first, second and third, with an index value of 0.323, 0.173 and 0.118, respectively. Cattle breeds and market availability can be considered as important opportunities of cattle production in the region though limiting constraints like feed shortage, diseases and drought are possible challenges.

Key words: Afar region, feed resources, cattle production, constraints, pastoral and agro-pastoral, production system.

INTRODUCTION

Livestock production is an integral part of the Ethiopian agricultural sector. The sub-sector contributes an estimated 12% to total gross domestic product (GDP) and over 45% to agricultural GDP (Ministry of Agriculture (MoA), 2010). On average, the pastoral livestock population accounts for an estimated 40% of the total livestock population of the country. Livestock play a significant role, directly or indirectly, in achieving food self-sufficiency in the country. Apart from its direct provision of food, it also provides draught power and

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income to farming communities, as well as means of investment and important source of foreign exchange earning to the nation (Ayele et al*.,* 2003). Of the total household cash income from crop and livestock, livestock account for 37 to 87% in different parts of the country; and the higher the cash income, the higher is the share of livestock, indicating that increased cash income comes primarily from livestock (Ayele et al., 2003). According to Temesgen et al. (2015), the livestock sector in Ethiopia plays a vital role in the overall development of the country's economy. Yet, the existing income generating capacity of livestock as compared to its immense potentials in the country is not encouraging.

In Ethiopia, according to Community-supported agriculture (CSA) (2003), 99.4% of the total cattle populations in the country are local breeds and the remaining are hybrids and exotic breeds that accounted for about 0.5 and 0.1%, respectively. Indigenous cattle are preferred to exotic/introduced ones for their robust environmental adaptive capacity. Subsistence smallholders select particularly female breeding animals for a range of desirable attributes, but some of these attributes are related to behavior and body conformation of the animals, which are not directly related to production functions (Bondoc et al., 1989; Dereje, 2005).

New Partnership for Africa's Development-Comprehensive Africa Agriculture Development Programme (NEPAD-CAADP) (2005) indicated that the lowlands in Ethiopia cover about 60% of the country's land area and are situated below 1500 m.a.s.l. The lowlands are situated in the Eastern, Southern, and Western part of the Central highlands (Afar, Somali, Borena, South Omo, some part of Gambela and Benishangul). According to the same source, the sector is characterized as pastoral and agro-pastoral production systems, where about 20% of cattle, 25% of sheep and 75% of goats of the total national livestock population are found. Ethiopia's lowland breeds of cattle, sheep, goats and camels are highly demanded by neighboring countries as well as the strategic livestock markets of the Middle East (Addis and Dida, 2015; Belachew and Jemberu, 2003). According to the same authors, the relatively huge number of livestock resources, proximity to the export markets, conducive investment policies, the liberalization of the economy, the supports and attentions given by the government to export trade gives the country comparative advantages in livestock trade.

Afar region is one of the four major pastoral regions in Ethiopia, located in north eastern part of the country. The region is divided into five administrative zones, which are further subdivided into 29 districts. The region is predominantly pastoral area, with 90% of the inhabitants depending on subsistence livestock production. Livestock production in the region depends on rainfed natural pasture whose productivity is declining as a result of recurrent drought, land degradation, encroachment of agriculture, conflict and invasion of weeds. The feed produced following the main rain season will lasts only two to three months and pastoralists are forced to migrate early (Joanne et al*.,* 2005).

On the other hand some indicators justifies the potential of the region for livestock production; diversified genetic resources of animals adaptable to the harsh environmental condition, high interest of people towards livestock production, vast areas of rangelands and proximity of the area to export routes. However, there is limited information and understanding about cattle management and marketing practices of the region. In order to take advantage of the potential of the region for livestock production, and enhance the attempt in the improvement of beef and/or milk production, there should be clear and sufficient base line information about cattle production as well as underlying socio-economic characteristics of the region. Therefore, this study was conducted with the following objectives:

- To assess socio-economic characteristics of cattle producers in Afar region.
- To study existing cattle management and cattle marketing practices in the region.
- To identify major opportunities and challenges of cattle production in the region.

MATERIALS AND METHODS

Description of the study area

Afar is one of the nine regional states situated in the north-eastern part of Ethiopia. The altitude of the region ranges from 1500 m.a.s.l. in the western highlands to -120 m.a.s.l in the Danakil/Dallol depression. It has an estimated population of 1.2 million, of which, 90% are pastoralists (56% male and 44% female) and 10% are agro-pastoralists. The livestock population is estimated to be about 4 million (Joanne et al., 2005). The region is characterized by arid and semi-arid climate with low and erratic rainfall. Temperatures vary from 20°C in higher elevations to 48°C in lower elevations. Rainfall is bi-modal throughout the region with a mean annual rainfall below 500 mm in the semi-arid western escarpments decreasing to 150 mm in the arid zones to the east (Joanne et al., 2005). Afar is increasingly drought prone. The region receives three rainy seasons. The main rain, *karma* accounts for 60% of annual rainfall and is from mid-June to mid-September. This is followed by rainy showers in mid-December called *dadaa* and a minor rainy season during March-April called *sugum.*

Methods of sampling and data collection

Both primary and secondary data were collected. Based on cattle resources and accessibility, three major cattle producing districts as well as three representative peasant associations (PA's) were purposively selected. Information about the socio economic characteristics of the area as well as cattle management and marketing practices were collected from individual interviews and focused group discussions. A total of 178 households were interviewed by using semi-structured questionnaires. Social and resource mapping of the study districts, personal observations at the time of visits and pre-testing of questionnaire were also conducted before actual data collection.

Table 1. Average age, sex and educational status of household head of the study districts.

Item	Aysaita	Chifra	Amibara	Overall	SE	P-value
HHH age	37.08	39.26	40.62	38.97	0.91	ns
No of male	2.70[b]	3.07[b]	3.93[a]	3.23	0.16	**
No of female	2.44[b]	3.00[ab]	3.53[a]	2.99	0.16	*
Male illiterates	0.18[b]	1.62[a]	1.95[a]	1.24	0.12	***
Male basic education	--	--	0.02	0.01	0.01	ns
Male religious education	0.03	--	0.02	0.02	0.01	ns
Male primary education	0.33[b]	1.15[a]	0.88[a]	0.78	0.08	***
Male secondary education	0.02[b]	0.33[a]	0.40[a]	0.25	0.05	**
Female illiterates	1.61[b]	1.69[b]	2.60[a]	1.97	0.15	**
Female basic education	1.09[a]	--	0.03[b]	0.39	0.08	***
Female religious education	0.11	--	--	0.04	0.03	ns
Female primary education	0.66[b]	1.28[a]	0.35[b]	0.75	0.07	***
Female secondary education	0.39	0.11	0.13	0.21	0.06	ns

[a, b] Means on the same row with different superscripts are significantly different ($p<0.05$). SE = Standard error; HHH = Household head; ns= Not significant; * $p<0.05$; ** $p<0.01$; *** $p<0.001$; -- = Zero value.

Data analysis

Data collected were analyzed using SPSS (SPSS, 2007). One way analysis of variance was carried out to test statistical variations among selected class variables (Districts, Sexes, Production systems). For class variables, means were separated using the Duncan multiple range test (DMRT). Indices were calculated for parameters that required ranking, which includes major feed type, major constraints in cattle production, and economically important cattle disease in the different districts. The indices were calculated with the following formula:

Index = Sum of (3 × number of household ranked first + 2 × number of household ranked second + 1 × number of household ranked third) given for an individual reason, criteria or preference divided by the sum of (3 × number of household ranked first + 2 × number of household ranked second + 1 × number of household ranked third) for overall reasons, criteria or preferences (Mula et al., 2006).

RESULTS AND DISCUSSION

Socio-economic characteristics of the study area

Household characteristics

The overall average age of the household heads was 39 years old, and ranged from 18 to 80 years (Table 1). This age was lower than 46.2 years old reported for cattle producers in North Gondar (Azage, 2009) and that of 44.3 years old reported for Fogera district (Belete, 2006). This result shows that young household heads are more common in lowland areas than the case in the highlands. As common to most pastoral areas in the country, the total number of persons in a household was big in the current study area. The average number of males and females in a household differed from district to district, though the male to female ratio was nearly equal. This study also revealed that the level of literacy was generally low in the area. The overall average number of illiterate male and female was 1.24 and 1.97 person per household, respectively.

Income sources of households

The list of major income sources in the study districts are presented in Table 2. Accordingly, livestock sale took the first rank while land rent and crop sale were the second and third major income sources, respectively. Employment and trade were other income sources of the households though to a smaller extent. The index value for crop sale which was 0.209 shows that there are pastoralists/agro-pastoralists that also produce crop but it does not indicate the amount of its economical contribution to the household to call them “agro-pastoral” boldly. Daniel (2008) reported that the major (49.3%) sources of income for pastoral households in Borena are livestock and crop production.

Land and livestock holding

The average land holding in the three districts was 2.07 ha per household (Table 3). The current result is smaller than the average land holding of 5.28 ha per household in Metema district (Tesfaye, 2008). This could be due to communal (clan or sub clan based) ownership of most of the grazing and browsing lands of each district. The overall average cattle holding per household heads was 17.35 heads (Table 3). This value was much greater ($p<0.05$) than the 8.7 heads per household reported for the North Gondar area (Azage, 2009) and 8.01 heads per household reported for the Mekelle area (Nigussie,

Table 2. Ranking of major income sources in the three study districts.

Item	Aysaita (mean index)	Chifra (mean index)	Amibara (mean index)	Overall
Livestock sale	0.429	0.459	0.478	0.455
Crop sale	0.368	0.219	0.039	0.209
Employment	0.050	0.014	0.055	0.040
Trade	0.000	0.000	0.009	0.003
Land rent	0.148	0.308	0.408	0.287
Others	0.005	0.000	0.011	0.006
Total	1.000	1.000	1.000	1.000

Table 3. Average land holding and livestock holding of respondents in the three districts.

Item	Aysaita	Chifra	Amibara	Overall	SE	P-value
Total land holding (ha)	2.11	1.98	2.50	2.07	0.25	ns
Cattle (n)	12.98^{b}	9.86^{b}	29.02^{a}	17.35	1.81	***
Sheep (n)	8.26	15.83	12.17	12.02	1.28	ns
Goat (n)	10.09^{b}	14.59^{b}	22.05^{a}	15.56	1.05	***
Horse (n)	0.06	--	--	0.02	0.02	ns
Donkey (n)	0.02^{b}	0.16^{a}	1.08^{a}	0.74	0.09	***
Camel(n)	1.07^{b}	3.71^{b}	13.12^{a}	5.96	1.04	***

$^{a, b}$ means on the same row with different superscripts are significantly different ($p<0.05$). SE = Standard error; ns= Not significant; *** $p<0.001$; -- = zero value.

2006). However, the current finding was comparable to that of Tesfaye (2008) who reported an average cattle holding of 15.53 heads per household in Metema district. Cattle holding per household were significantly ($p<0.05$) higher in Amibara (29.02) than that of Aysaita (12.98) and Chifra (9.86) districts. Regarding the composition of other herds in the three districts, the overall average number of sheep, goat, camel, donkey and horse were 12.02, 15.56, 5.96, 0.74 and 0.02 heads per household, respectively.

Livestock and crop production systems

In the present study, it was observed that both production systems existed in the districts. However, the extent of involvement of respondents in these two systems is variable among the districts. As presented in Figure 1, overall, 53% of the respondents were engaged in livestock production, while the remaining 47% were engaged in both livestock and crop production. There was no data in this study that indicate the magnitude of the economic contribution of these two productions to the household. As a result, it is difficult to judge that the 46.6% respondents that produce both livestock and crop are engaged in agro pastoral production system. A study by Mohammed and Abule (2015) indicated that crop production was practiced by agro-pastoralists in upper altitudes of Chifra district, using irrigation water.

As prioritized by the respondents, maize, tomato and onion were the first, second and third major crops grown in the study districts. It was also noted that sesame, sorghum and cotton are also other crops grown in these districts, as mentioned by few of the respondents in the current study area.

Cattle management practices in the study area

Purpose of rearing cattle

The majority (95%) of the respondents reared cattle to produce milk for household consumption (Figure 2). However, very few of them mentioned ‘market sale’ (2.3% of the cases) and ‘social security’ (2.2% of the cases) as their major reason for cattle rearing.

Family labour for cattle production

In all the study districts, it was found that most of the field works were taken by the husband and boys, while the homestead works were left for wives and girls. As reported by 87.7% of the respondents, responsibility of selling and purchasing of cattle were handled by the

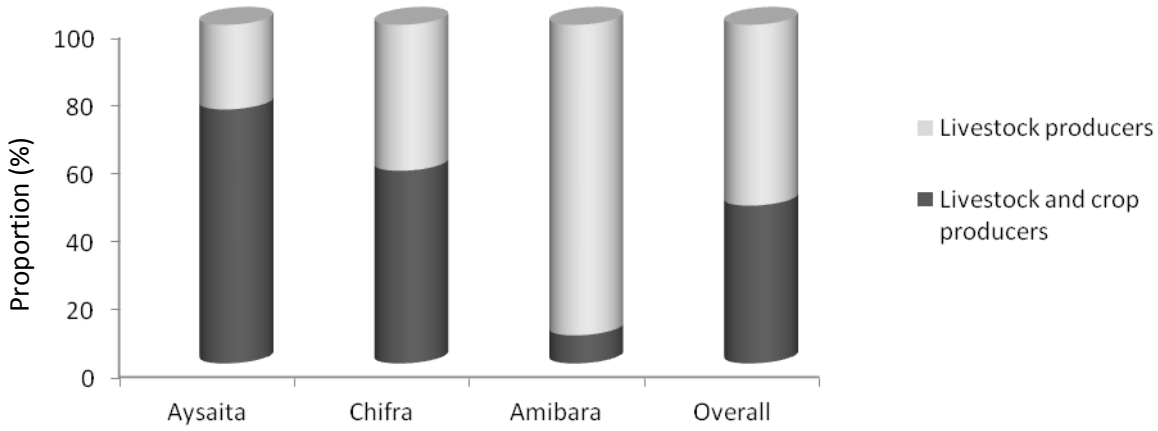

Figure 1. Proportion (%) of respondents to the main production systems they practice in the study area

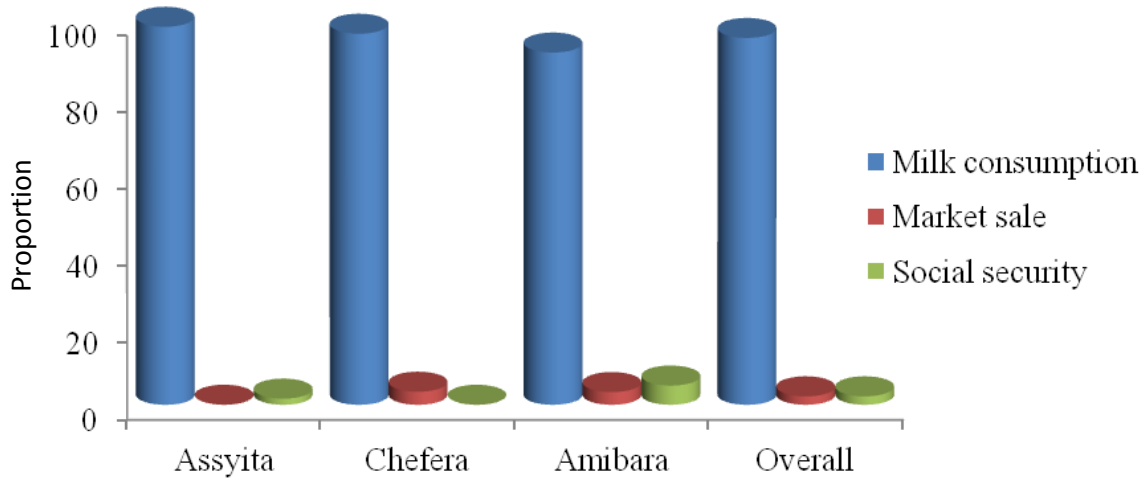

Figure 2. Proportion of respondents to major reason for cattle rearing in the study districts.

husband. Most of them (79.9%) also agreed that herding could be carried out by both husband and boys. On the other hand, activities such as cattle barn cleaning, taking care of calves, milking (except camels), milk processing and marketing were handled by wives and girls. According to CSA (2003), family workers constitute the highest proportion (56%) of the population in agricultural households who were engaged in agricultural activities at country level. In addition, about 38% of the working population was personal account workers working in their farms alone or with the help of family members, but without hiring labor.

Cattle feeding and housing practices

The major feed resource for cattle in the study areas was contributed by natural pasture. Almost all (97.8%) of the respondents indicated that they allowed their cattle to continuously graze on communal pasturelands, though the availability and quality of feed greatly varied from season to season. In Assayita district, very few respondents began cultivation of improved forages in their backyards and thus attempted 'cut and carry' feeding practices (Table 4). This study also revealed that many of the respondents (67.6%) constructed barn for their cattle and other livestock, while the remaining (32.4%) of them gathered their animals in their homestead without fence (Table 4). This could be due to the practice of keeping large herds together, though each herd belonged to distinct households.

Drinking water sources

In the study districts, rivers, springs, tap water, ponds and

Table 4. Cattle feeding, forage cultivation and cattle housing practices in the study districts.

Item	Proportion of respondents (%)			
	Aysaita (n=60)	Chifra (n=58)	Amibara (n=60)	Overall (n=178)
Feeding practices				
Continuous grazing	93.4	100.0	100.0	97.8
Continuous and zero grazing	6.6	--	--	2.2
Forage cultivation practices				
Yes	18.0	10.3	1.7	10.1
No	82.0	89.7	98.3	89.9
Cattle housing practices				
Fenced barn	85.2	56.9	60.0	67.6
Unfenced barn	14.8	43.1	40.0	32.4

Table 5. Sources of water for livestock in the study districts.

Item	Proportion of respondents (%)			
	Aysaita (n=60)	Chifra (n=58)	Amibara (n=60)	Overall (n=178)
Rivers	95.2	41.4	78.3	72.1
Springs	--	--	10	3.3
Tap water	--	--	6.7	2.1
Rivers and wells	1.6	--	--	0.6
Multiple responses	3.2	58.6	5	21.9

Multiple responses: rivers, springs, tap water, ponds and wells; -- = not available.

wells were mentioned as important water sources of the study areas (Table 5). Most (72.1%) of the respondents mentioned rivers as the major sources of water for their animals, but other water sources were not sufficiently available throughout the year. When rivers dry up and critical water shortage occur, especially during dry season, few cattle producers use tap water and wells, while most others are forced to go too far watering areas as a coping strategy. However, these strategies were not consistent among the respondents of the three districts. This indicates a lack of commonly agreed utilization practices of water resources in the region (Table 5). According to Coppock (1994), the Borana mostly use ponds during the rainy season and wells during the dry season to avail water for human and livestock.

Cattle breeding techniques

Two types of mating systems, referred as controlled and uncontrolled natural mating systems, were practiced in the study districts. Accordingly, most of the herders (60.9%) used uncontrolled natural mating system while the rest (39.1%) used natural controlled mating system (Table 6). Even though the proportion of respondents to the type of matting system they use for cattle breeding was variable among districts (Table 6), it is imperative to note that the natural controlled matting system is also recognized in the study areas. It is also clear that the degree of applicability of this system is prone to several factors including the commitment of herders, herd size and availability of desired bull. Traditionally, pastoralists cull inferior bulls and less productive cows regardless of the mating system they followed in cattle breeding. Most of the producers (59.3%) used their own bull for breeding purpose, some (17.3%) of them used neighbors' bull and the rest (23.5%) relied on any of the alternatives (their own, neighbors' and/or communal bulls). This could be also one of the reasons why both matting systems prevailed in the study districts.

The breeding season of cattle was also assessed in the three study districts. About 37 and 27% of the respondents revealed that calving usually took place during *kerema* (main rainy season) and *sugume* (short rainy season), respectively. However, 17% of the respondents mentioned that calving could occur during *gilal* (dry season). This could be due to the difference in management of cattle (especially feeding and

Table 6. Matting systems and source of bull used for cattle breeding in the three study districts.

Item	Proportion of respondents (%)			Overall (n=178)
	Aysaita (n=60)	Chifra (n=58)	Amibara (n=60)	
Matting systems				
Natural controlled	18.0	56.9	43.3	39.1
Natural uncontrolled	82.0	43.1	56.7	60.9
Source of bull				
Own bull	57.5	62.0	58.3	59.3
Neighbor	18.0	24.2	10.0	17.3
Multiple responses[1]	24.5	13.8	31.7	23.4

[1]Multiple responses: own, neighbor and communal bull.

Table 7. Reproductive traits of Afar cattle as reported by herders of the study districts

Item	Average age					
	Aysaita	Chifra	Amibara	Overall	SE	P-value
Age at first service (yrs)	2.96	3.16	3.34	3.15	0.06	Ns
Age at first mating (yrs)	3.41	3.53	3.64	3.51	0.07	Ns
Age at first calving (yrs)	3.79[b]	4.17[a]	4.32[a]	4.09	0.06	**
Reproductive lifetime of bulls (yrs)	7.28[b]	10.74[a]	11.38[a]	9.75	0.38	***
Culling age of breeding bull (yrs)	8.45[b]	12.18[a]	12.67[a]	11.01	0.43	***
Culling age of breeding cow (yrs)	10.72[b]	13.50[a]	14.95[a]	12.99	0.34	***
Reproductive lifetime of cows (yrs)	10.79[b]	13.34[a]	13.55[a]	12.66	0.31	***
Calving interval (months)	13.36	14.98	14.00	14.11	0.36	Ns

[a, b] Means on the same row with different superscripts are significantly different ($p<0.05$). SE = Standard Error; ns= Not significant; ***$p<0.001$; yrs = Years

watering) or extent of controlled mating among the districts.

The reproductive performance of Afar cattle

Under normal condition, calves reach the age of first sexual maturity at about 3.5 years, and the average reproductive lifetime of cows mentioned was 12.7 years (Table 7). Some of the reproductive traits of cattle in Aysaita district varied from that of Chifra and Amibara. This could be due to better feed and management conditions in Aysaita. Cattle in this district might be also from a different ecotype, as they appeared visually different from the rest in the region. Similarly, ecotype variation of cattle breeds was reported in South Africa (Sanarana et al., 2015).

Cattle marketing practices in Afar region

Live cattle marketing

During focus group discussion, several market places were mentioned as possible destinations for cattle marketing by the respondents. The prominent were Dulecha, Awash, Werer, Chifra and Aysaita town markets. On the contrary, it was noted in this study that cattle were marketed by most (96.6%) of the respondents for several reasons. The possible reasons mentioned by them were to earn additional income, to replace old stock, to buy school materials for their children and/or to cover medication costs. They also discussed that cattle marketing was preferred at the closest market places for each district. Unfortunately, market places were farther than 20 km from settlement areas of pastoralists of Amibara and Chifra districts that favored middlemen to be the dominant actors of the market due to their capacity to easily access vehicles for transportation to settlement areas as well as market places.

Cattle could be sold at different ages and sexes in all of the study districts (Table 8). However, the majority (68.7%) of cattle owners preferred selling male cattle at younger age, while the remaining preferred selling their male cattle at different age. Most (61.5%) of them also preferred selling female cattle at old age. In both cases, the remaining respondents justified the reasons why male or female cattle could be sold at different age. They mentioned that health conditions, feed availability, production history of the cattle and immediate cash

Table 8. Proportion (%) of respondents for preferred age of male and female cattle to be sold.

Item	Aysaita (n=60)		Chifra (n=58)		Amibara (n=60)		Overall (n=178)	
	M	F	M	F	M	F	M	F
Immature	23.0	1.6	--	--	--	--	7.8	0.6
Young	45.8	6.6	81	13.8	80	20	68.7	13.4
Old	11.5	45.9	5.3	75.9	8.4	63.3	8.4	61.3
All	11.5	--	3.4	--	--	1.6	5	0.6
Immature and young	4.9	6.6	6.9	1.7	8.3	--	6.7	2.8
Immature and old	3.3	37.7	3.4	6.9	3.3	11.7	3.4	19.0
Not fertile (infertile)	--	1.6	--	1.7	--	3.4	--	2.3

--= The proportion is zero; M= male cattle; F= female cattle.

requirement by the producer were the possible reasons in this regard.

Dairy products marketing

Selling of milk and milk products is practiced by most (70.9%) of the respondents for similar reasons as that of the reasons for selling live cattle. On the other hand, few (29.1%) of them insisted that cattle products are meant for household consumption only, unless surplus production is obtained. During periods of surplus milk production, many (64%) of the respondents sell butter than milk and other milk products.

Opportunities and challenges of cattle production in Afar region

The opportunities and challenges of cattle production in the region are extracted and discussed here based on the results discussed and other supportive literatures. This implies that specific data were not collected for examining the opportunities and challenges of cattle production in the study area due to the dynamic and complex nature of pastoral production system. Thus, this study addresses only the most common and agreeable issues that were mentioned, discussed and/or observed by cattle producers, important stakeholders and researchers during the study period.

Opportunities of cattle production in the region

Availability of resources for production: It is clear that land, labour and capital are the major resources required for the production of most agricultural commodities. As discussed earlier, landholdings are generally higher in pastoral areas. Likewise, the three study districts have large area of grazing lands and many browsing plants, which has supported extensive cattle production to date. Availability of rivers and extensive irrigable lands are also added opportunities in the area. In this regard, intensive beef or dairy production can be envisaged in Amibara and Aysaita districts. Pastoralism is the major production system in the region, where native inhabitants have long years of experiences in livestock production; and most members of a household are directly or indirectly involved in livestock activities. The region is advantageous in exploiting inter regional labour flow due to its geographical position in the country. As a policy strategy in the improvement of national economy, the government has created possibilities of obtaining loans and credits at different investment scales.

Afar cattle breeds as genetic source for livestock production in the region: Cattle herd sizes are generally large in pastoral areas (Asfaw et al*.,* 2011). Similarly, larger livestock holdings per households were recorded in the study districts as compared to some areas in the country (Table 3). Traditionally, Afar pastoralists cull inferior animals and try to maintain the good ones. In most pastoral areas of the country, cattle are primarily reared for milk production (International Livestock Research Institute (ILRI), 2010), and similar practice was understood in this study. This may serve as genetic reserve of the breed in the region.

Market opportunity due to increased demand for beef consumption: Livestock has been continuously marketed between different regions of the country (Asfaw et al., 2011) due to the increased demand for meat consumption. Increasing trend of cattle off-take was recognized by pastoralists of the study area through intra and inter-regional market outlets. Increased demand for beef in the Middle East countries was reported by Daniel (2008), which can be considered as added opportunity.

Recent pastoral resettlement program: It was observed during the survey work that pastoralists began to settle and produce crops besides livestock production. This could be taken as an opportunity for the establishment of intensive livestock production for increased milk or meat production in these areas.

Table 9. Constraints of cattle production in the three study districts.

Item	Index values			
	Aysaita	Chifra	Amibara	Overall
Flood	0.046	0.005	0.000	0.018
Robbery	0.000	0.000	0.095	0.032
Conflict	0.000	0.000	0.069	0.023
Drought	0.071	0.235	0.231	0.178
Diseases	0.197	0.241	0.142	0.193
Predator	0.000	0.012	0.019	0.010
Feed shortage	0.566	0.426	0.259	0.418
Bush encroachment	0.035	0.023	0.022	0.027
Water shortage	0.057	0.052	0.151	0.087
Market problem	0.000	0.006	0.006	0.004
Vet. Services	0.028	0.000	0.006	0.011
Total	1.000	1.000	1.000	1.000

Table 10. Ranking of economically important cattle disease by pastoralists of the study districts.

Parameter	Index value			
	Aysaita	Chifra	Amibara	Overall
Guduf	0.781	0.051	0.119	0.323
Gubulo	0.054	0.242	0.053	0.115
Migeda	0.000	0.095	0.124	0.073
Asdaho	0.000	0.000	0.017	0.006
Kida	0.006	0.043	0.002	0.018
Andero	0.049	0.002	0.000	0.017
Agara	0.008	0.000	0.016	0.008
Noke	0.000	0.052	0.017	0.023
Mesengeli	0.022	0.037	0.294	0.118
Abeb	0.005	0.052	0.047	0.034
Kilime	0.019	0.000	0.116	0.045
Kirbi	0.052	0.003	0.086	0.047
Fira	0.003	0.422	0.105	0.173
Total	1.000	1.000	1.000	1.000

Challenges of cattle production in the region

Drought and critical periods of feed shortage: As reported by Joanne (2005), drought has been recorded in Afar region since 1988 and was recurring within an average of 10 years interval. However, pastoralists agreed during group discussion that drought occurred almost every year and the number of households being affected increased yearly since the last few decades. Feed and water shortage, drought, diseases, encroachment of bush to grazing lands, predator, robbery, conflict, flood, shortage of veterinary services and market problem were also mentioned as major constraints of cattle production in the region (Table 9). Pastoralists recognized different seasons of feed shortage in the region, though variable responses were given for critical periods. In this regard, some (40.8%) of them prioritized *hagay* (hot dry season), and some others (20.1%) prioritized *gilal* (dry season), while the remaining (31.3%) mentioned both *gilal* and *hagay* as the seasons with worst conditions.

Cattle diseases problems: Cattle producers listed a number of economically important cattle diseases in the three districts, and ranked them according to their importance (Table 10). In overall, *Guduf* (lumpy skin disease), *Fira* (Anthrax) and *Mesengeli* (pneumonia due to pastuerollsis) with an index value of 0.323, 0.173 and

0.118 were ranked as first, second and third major prevalent diseases, respectively. Accordingly, the result indicated that *Guduf* was the first prevalent diseases in Aysaita distict with an index value of 0.781, though it was the third prevalent diseases in Chifra and Amibara *districts* with index values of 0.051 and 0.119, respectively. *Fira*, *Gubulo* (Contageous Bovine Pleuro Pneumonia) and *Migeda* (anthrax/Sudden death) with an index values of 0.422, 0.242 and 0.095 were ranked as first, second and third major prevalent diseases in Chifra district, respectively. Furthermore, *Asdaho* (Baberiosis), *kida* (unidentified), *andero* (Trypanososmosis), *agara* (Mange mites), *noke* (paralysis/Tetanus), *abeb* (foot and mouth disease), *kilime* (tick infestation) and *kirbi* (Fasciolosis) were other diseases mentioned by the respondents.

Most of the respondents relied on government veterinary services, though the services were not sufficient and sustainable. The drugs supplied by the district agricultural bureau to the local clinics were not enough, especially during the occurrence of disease outbreak. As a result, pastoralists of the study area bought drugs from private veterinary drug suppliers with expensive prices. Sometimes, drugs purchased from the local market were poor in quality or totally expired, as discussed by the group.

Conclusion

As common to most pastoral areas of Ethiopia, grazing was the major feeding system practiced by these communities. River is the main source of water supply for animals in these areas. Most of the producers followed uncontrolled natural mating system. Most cattle producers sold their cattle to earn additional income, to replace old stock and/or to buy school materials for their children. Market areas were generally far in all of the study districts. Cattle were sold depending on their age and sex. Most respondents sold male cattle at younger age and female cattle at old age. In this study, lumpy skin disease, sudden death and pneumonia were mentioned as major cattle diseases in the area.

The constraints of cattle production system of sample households in the study area were feed shortage, water shortage, drought, diseases, encroachment of grazing land by bush/weed, predator, theft, conflict, flood, shortage of veterinary services and market problems. This study revealed that resources, cattle breeds and market availability can be considered as important opportunities of cattle production in the region though limiting constraints like feed shortage, diseases and drought are possible challenges.

Considering the huge cattle potential of the region; milk and meat production capacity of Afar cattle breed need to be scientifically studied to know the genetic potential and further improvement of the breed, technologies in feeds and nutrition need to be generated to make better use of male cattle obtained from continuous culling process. The promotion and scaling up of proved forage production should be encouraged to solve the problem of seasonal feed shortage in the area. Training and extension advices should be regularly given to producers in the management and marketing of cattle to gain better from the resources. Cattle diseases should be well studied in depth to devise their control and prevention strategies in the region. There is the need to develop strategies by the government for the establishment of intensive cattle production in the region, either for domestic consumption or foreign market competition.

Conflict of interest

The authors have not declared any conflict of interest

REFERENCES

Addis BA, Dida KG (2015). Review on factors affecting livestock market price in lowland area of Ethiopia. Adv. Life Sci. Technol. 37: ISSN 2224-7181.

Asfaw N, Shahidur R, Berhanu G (2011). Livestock production and marketing: Ethiopia Strategy Support Program II (ESSP II), Working Paper 26. Development Strategy and Governance Division. International Food Policy Research Institute, Ethiopia.

Ayele S, Assegid W, Belachew H, Jabbar MA, Ahmed MM (2003). Livestock marketing in Ethiopia. A review of structure, performance and development initiatives. Socio-economics and Policy Research Working Paper 52. ILRI (International Livestock Research Institute), Nairobi, Kenya. P 35.

Azage T (2009). Transhumance cattle production system in north Gondar Amhara region, Ethiopia. International Livestock Research Institute (ILRI), Addis Ababa, Ethiopia.

Belachew H, Jemberu E (2003). Challenges and opportunities of livestock marketing in Ethiopia. Proceeding of the 10th annual conference of the Ethiopian Society of Animal Production (ESAP), on challenges and opportunities of livestock marketing in Ethiopia, held on August 22-24, 2002 in Addis Ababa, Ethiopia. pp. 1-13.

Belete AT (2006). Studies on cattle milk and meat production in Fogera woreda: Production systems, constraints and opportunities for development. MSc thesis. Hawassa University, Hawassa, Ethiopia.

Bondoc OL, Smith C, Gibson JP (1989). A review of the breeding strategies for improvement of dairy cattle in developing countries. Anim. Breed. Abstr. 57:819.

Central Statistics Agency (CSA) (2003). Statistics report on land utilization. Agricultural sample survey, Volume IV. CSA, Addis Ababa, Ethiopia.

Coppock DL (1994). The Borena plateau of southern Ethiopia: Synthesis of pastoral research, development and change, 1980-91. ILCA (International Livestock Centre for Africa), Addis Ababa, Ethiopia.

Daniel T (2008). Beef cattle production system and opportunities for market orientation in Borena Zone, Southern Ethiopia. MSc thesis. Haramaya College of Agriculture, School of Graduate Studies, Haramaya University, Haramaya, Ethiopia.

Dereje T (2005). On-farm phenotypic characterization of cattle genetic resources and their production systems in south and north Wello zones of Amhara region, Ethiopia. MSc Thesis. Alemaya University, Ethiopia.

International Livestock Research Institute (ILRI) (2010). Diagnostic study of live cattle and beef production and marketing: Constraints and opportunities for enhancing the system. (Unpublished). ILRI, Addis Ababa, Ethiopia.

Joanne P, Asnake A, Kassaye H (2005). Livelihood emergency assessment in Afar region, OXFAM International. Addis Ababa, Ethiopia. P 44.
MoA (2010). Ethiopia's Agricultural Sector Policy and Investment Framework (PIF) 2010 -2020 (Draft Report). Addis Ababa: Ministry of Agriculture and Rural Development.
Mohammed A, Abule E (2015). Assessment of pastoral perceptions towards range and livestock management practices in Chifra district of Afar regional state, Ethiopia. J. Food Sci. Technol. 6(4):118-130.
Mula J, Poler R, Garcia JP, Lario FC (2006b). Models for production planning under uncertainty: A Review. Int. J. Prod. Econ. 103:271-285.
New Partnership for Africa's Development–Comprehensive Africa Agriculture Development Programme (NEPAD–CAADP) (2005). Ethiopia: Investment project profile 'Live Animal and Meat Export'-Preliminary options outline. P 3.
Nigussie G (2006). Characterization and evaluation of urban dairy production system of Mekele city, Tigray Region, Ethiopia. MSc thesis. Hawassa University, Hawassa, Ethiopia.
Sanarana Y, Visser C, Bosman L, Nephawe K, Maiwashe A, van Marle-Köster E (2015). Genetic diversity in South African Nguni cattle ecotypes based on microsatellite markers. Trop. Anim. Health Prod. 48(2):379-385. Statistical Procedures for Social Sciences (SPSS) (2007). (SPSS Version 16) INC. Chicago, Illinois, USA.
Temesgen G, Aleme A, Mulata H (2015). Climate change and livestock production in Ethiopia. Academia J. Environ. Sci. 2(4):059-062.
Tesfaye MD (2008). Characterization of cattle milk and meat production, processing and marketing system in Metema district**.** MSc thesis. Hawassa College of Agriculture, School of Graduate Studies, Hawassa University, Hawassa, Ethiopia.

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