Productive performance of primiparous Baladi cows and their F1 crossbreds with French Abondance and Tarentaise

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A total of twenty four primiparous lactating cows (8 Baladi (B), 8 Baladi x Abondance (B x A) and 8 Baladi x Tarentaise (B x T)) were used to compare their potential in milk production. Production data (milk yield, days in milk) were recorded. Fortnightly milk and blood samples were collected starting two weeks postpartum till drying off to analyze the gross chemical composition of milk and quantify IGF-1 and leptin in blood.

Baladi cows were the lowest ($P<0.0001$) in milk yield 727.7 kg in 156.3 days in milk. No significant differences were detected in milk yield between the two examined crossbred cows (1322.3 and 1656.6 kg milk in 191.5 and 236.0 days in milk for B x A and B X T, respectively). Data of the gross chemical composition of milk (fat, protein, lactose, total solids and solids not fat percentages) showed non significant differences among the examined genotypes. Slight increase in milk protein, lactose, total solids and solids not fat were noticed in B x A crossbred compared to the other genotypes. Values of milk urea nitrogen (mg/dl) were in the normal range without any significant differences among the studied genotypes.

Values of IGF-1 (ng/ml) were lower ($P< 0.05$) in B cows (143.3) than B x A (195.8 ng/ml) and B x T (239.2 ng/ml) crossbreds. The values of leptin (ng/ml) were higher in B x A (14.7) than B x T (13.4) than B (12.27).

Upgrading Baladi cows with either French Abondance or French Tarentaise improved significantly milk yield with longer days in milk without any noticeable change in the studied milk constituents. Also, the measured blood parameters may add some explanations to the superiority of Baladi x Abondance, Baladi x Tarentaise over Baladi cows in milk production. More research is needed to investigate the impact of the upgrading of Baladi cows with European genotypes concerning reproductive performance.

Key words: IGF-1, leptin, Milk yield, Abondance and Tarentaise crossbreds

Introduction

The contribution of cattle population in Egypt is estimated to be 4.61 million head which is 34.5% of the total ruminants. The Baladi cows and their crossbreds produce 52.7% of the total milk production and 65% of the total red meat (MOA, 2007).

Upgrading Baladi cows with European breeds were to improve their productivity (Cunningham and Syrstad, 1987 and Lopez *et al.*, 2005). The Abondance and Tarentaise cattle are dual purpose French breeds and known for their abundant muscling in the hip region and low milk production (Boutinaud and Jammes 2002).

The serum values of IGF-1 and leptin may add an explanation to the superiority of a genotype in lactogenesis. The IGF-1 plays a major role in mammary growth, regenerative process and mediates several biological effects of growth hormone. Changes in serum IGF-1 concentration are positively correlated with milk persistency (Akers 2006, Sorensen *et al.* 2006, Sorensen and Knight, 2002 and Capuco *et al.* 2001) and increased with the advancement of lactation (Miller *et al.*, 2006). Also, leptin plays an important role in the regulation of feed intake, stimulates peripheral lipolysis, increases general metabolism, promotes the peripheral use of lipids as an energy source and modulates the response to different hormones (Accorsi *et al.*, 2007 and Ziba *et al.*, 2005)

The objective of this study was to examine the variation in milk yield, milk constituents among primiparous Baladi cows and their F1 crossbreds with Abondance and Tarentaise French breeds. Also, to examine if serum concentration of IGF-1 and leptin could add an explanation to the superiority of any of the examined genotypes.

MATERIALS AND METHODS

A total of twenty four primiparous lactating cows (8 Baladi (B), 8 Baladi x Abondance (B x A) and 8 Baladi x Tarentaise (B x T)) were utilized in this experiment. The animals were kept under semi shed open yards. All the feeding allowances of the experimental cows were calculated and adjusted according to their production using NRC requirements (NRC, 1998).

Production traits were actual milk yield, days in milk and days dry. The 305 milk yield was calculated using the ICAR equation (Total milk yield / (100+days in milk))*405, International Committee for Animal Recording (ICAR, 2000).

Fortnightly milk and blood samples were collected starting two weeks postpartum till drying off to analyze the gross chemical composition of milk and quantify IGF-1 and leptin in blood. Gross Chemical composition of milk samples was performed using Milkoscan® analyzer, Bently 150, USA. A direct single antibody Radioimmunoassay (RIA) technique was performed for the quantification of serum Insulin-like Growth Factor-1 (IGF-1) ng/dl using Biosource kit according to Koch *et al.* (1995). A Sandwich ELISA technique was performed to quantify Leptin (ng/dl) using DRG kits according to Guillaume and Bjorntorp (1996).

For serum IGF-1 quantification, inter and intra assay coefficient of variability were 9.1% and 9.0%, respectively, according to the manufacturer. The minimum detection limit of the assay was 3.4 ng/ml. The cross reactivity of the assay were 100% for IGF-1, 0.7% for IGF-II and not detectable (ND) for Insulin and GH. For serum leptin quantification, the inter and intra assay coefficient of variability were (11.55 to 8.66%) and (5.95 to 6.91%), respectively according to the manufacturer. The minimum detection limit of the assay was between 1.0 – 100 ng/ml. The cross reactivity of the assay were 100% for human leptin, <0.2% for both of rat and mouse leptin.

The data set was subjected to the general linear model of SAS (SAS, 2000). The differences among means were tested using Duncan test (Duncan, 1955).

The following model was utilized:-

Y_{ij} = μ + $(Breed)_i$ + e_{ij}, whereas,

Y_{ij} = an observation, μ= Overall means, $(Breed)_i$ = $_i$ = 1 for 1/2 Abondance x 1/2 Baladi, $_i$ = 2 for 1/2 Tarentasi x 1/2 Baladi, $_i$ = 3 Pure Baladi.

e_{ij} = experimental error assumed to be randomly distributed (0, σ2).

RESULTS AND DISCUSSION

The two crossbreds (BxA & BxT) showed adaptability to the surrounding environment and expressed their genetic potential in lactogenesis in an excellent manner (Fig. 1). Table (1) showed that the Baladi cows had the shortest days in milk (DIM) with the lowest milk production (782.5 kg in 157.2 days) and the superiority of milk production with longer days in milk for crossbred Baladi cattle with European breeds over the Baladi cows. These findings are also reported by Cunningham and Syrstad (1987) on Shorthorn, Mostageer, *et al.* (1990) on Angler, Brown Mountain, Germen Brown and Grey Mountain crossbreeds. Current days dry was the highest (163±3.8) in Baladi cows. Abraha *et al.* (2009) used 32 postpartum cows (16 indigenous, 16 crossbred), they found that daily milk yield at all stages of lactation were significantly ($P<0.01$) higher in crossbred than indigenous cows. Crossbred cows had significantly ($P<0.01$) longer lactation length.

The longest dry days ($P<0.05$) were noticed in Baladi cows (163 days) compared to the other two crossbreds. Dry days were almost the same in both crossbreds (69.5 and 65.0, respectively). It agrees with the recommended days dry between two lactations needed for the remodeling, re-stimulation, increase body reserve and increase lactogenic activity as mentioned by (Akers 2006, Sorensen *et al.* 2006 and Akers, 2002).

There was a significant ($P<0.05$) increase in total protein% in BxA (3.2%) compared to B (3.1%) and BxT (3.04%). The difference between the other two groups was not significant. This percent was slightly lower in Baladi cows (3.7%), with range of 2.5 and 5.3%, while this percent in both of the other two groups (BxA) and (BxT) were 3.8% with the range of 2.9 – 4.9 for (BxA) and 2.6 – 4.8 for (BxT). But these differences between genotype groups were not significant and may be due to the genotype effect.

Dechow *et al.* (2007) concluded that crossbreeding will allow dairy producers to match the genotype of dairy herd to farm management conditions. They showed that Brown Swiss-sired cows from Holstein dams had higher fat (1.27 kg) and protein (1.02 kg) production per day than pure Holstein (1.21 kg for fat, 1.00 kg for protein).

Auldist *et al.* (2007) found that the percentage of fat in Holstein and (Holstein x Jersey) were 3.7 and 4.04%, respectively. Ferlay *et al.* (2006) concluded that the percentage of fat was 3.8% in Tarentaise cows during mid lactation. Godden *et al.* (2001) concluded that milk fat (%) in Holstein dairy cows was 3.8%.

Table 1. Production traits (LSM ± SE) of primiparous Baladi cows (B) and their F1 crossbreds with French breeds Abondance (BxA) and Tarentaise (BxT)

Items	Milk yield	Days in milk	Days dry
B	727.7^{b}±152.1	156.3^{b}±22.8	163.0^{a}±3.8
	(498-1329)	(49-199)	(150-174)
B x A	1322.3^{a}±380.6	191.5^{b}±47.02	69.5^{b}±12.1
	(295-2050)	(56-286)	(51-105)
B x T	1656.5^{a}±289.8	236.0^{b}±34.5	65.0^{b}±5.1
	(530-2395)	(72-296)	(47-85)

Means having different superscript letters within the same column differ significantly (P<0.05). Between parentheses is the range.

Miller *et al.* (2006) working on Holstein dairy cows, reported that milk fat in early and late lactation was 3.96 and 4.3%, respectively tended to be raised than in mid lactation by 3.7%. Santos *et al.* (2004) recorded that the percentage of fat in Holstein dairy cows was 3.31%.

Milk urea is an indicator of the efficiency of lactogenesis and udder health. Obtained values for milk urea in Baladi cows and their crossbreds were in the normal and acceptable range reported by Baker *et al.* (1995), Jonker *et al.* (2002) and Hojman *et al.* (2004)

The concentrations of milk urea (mg/dl) in Baladi (B) and their crossbreds with Abondance (BxA) and Tarentaise (BxT) are presented in Table (5). These concentrations were 22.6, 21.02 and 21.6 mg/dl, respectively. The overall mean was 21.7 mg/dl for all breeds. The minimum and maximum values for B, BxA and BxT were (11.1-33.2), (6.6-29.8) and (21.5-30.8) mg/dl, respectively.

These results are in agreement with Hanus *et al.* (2008) who mentioned that the milk urea concentration (mg/100 ml) was ranged between 3.36 and 51.12.

Oudah (2009) found that milk urea was lower (30.7 mg/dl) during the first 30 DIM compared with all other DIM categories. The overall mean of milk urea concentration in Holstein dairy cows was 31.7 mg/dl, and it was ranged between 10 and 60 mg/dl. They mentioned that these differences in milk urea may be due to season, month, parity, stages of lactation and sample type.

Baladi cows had the lowest value of IGF-1 than BxA and BxT by 36.6% and 66.9%, respectively, the values were 143.3 ng/ml *vs.* 195.8 and 239.2 ng/ml, respectively. While, the minimum and maximum values were 134.4 – 217.9 ng/ml, 93.4 – 292.8 ng/ml and 118 – 350.5 ng/ml among the three genetic groups, respectively, with the overall mean 192.8 mg/ml. As shown in Fig 2. the changes in serum IGF1 in the examined genotypes may add an explanations of the changes in average daily milk yield, also explain its role in lactogenesis.

Kadokawa *et al.* (2006) found that the mean of IGF-1 concentration in early postpartum Holstein cows was 18.9 ng/ml, while the minimum values was 6.40 ng/ml and the maximum was 45.44 ng/ml. Obese *et al.* (2008) recorded that the average of IGF-1 concentration in Holstein cows was ranged from 29.1 to 96.4 ng/ml.

Table 2. Milk constituents and milk urea nitrogen (mg/dl) (LSM±SE) in Baladi cow (B) and their crossbreds with Abondance (BxA) and Tarentaise (BxT).

Items	**Protein**	**Fat**	**Lactose**	**Urea**	**TS**	**SNF**
B	3.1^{b}±0.05 (2.3-4.2)	3.7^{a}±0.07 (2.5–5.3)	4.2^{b}±0.07 (2.6-4.9)	22.6^{a}±0.06 (11.1-33.2)	12.4^{a}±0.1 (10.3-13.8)	8.7^{a}±0.1 (7.3-10.1)
B x A	3.2^{a}±0.05 (2.1-4.1)	3.8^{a}±0.06 (2.9-4.9)	4.4^{a}±0.04 (3.1-4.9)	21.02^{a}±0.6 (6.6-29.8)	12.5^{a}±0.11 (10.3-14.3)	8.8^{a}±0.08 (7-10)
B x T	3.04^{b}±0.04 (2 - 4)	3.8^{a}±0.06 (2.6-4.8)	4.5^{a}±0.04 (3.7-5.2)	21.6^{a}±0.4 (21.5-30.8)	12.3^{a}±0.1 (9.5-13.9)	8.4^{b}±0.1 (7.0-9.9)

Means having different superscript letters within the same column differ significantly (P<0.05). Between parentheses is the range.

Higher serum IGF-1 values in crossbred cows explain their lactogenic potential in compare to the lowest value of IGF-1 in Baladi cows.

The values of Leptin were higher in crossbred cows than that in Baladi cows. Leptin value is proportionally correlated with the live body weight being lower in lighter cows (Baladi) and higher in heavier cows (crossbreds). Also, leptin is correlated with milk yields and constituents being higher in high yielders (crossbreds) and lower in low yielder (Baladi). As shown in Fig 3., Leptin values were higher at the declining phases of lacation being the lowest at late lactation which in turn confirm that leptin values reflect the changes in live body weights due to the dairy drive.

Baladi cows had the lowest value (12.3 ng/ml) of leptin in compare to their crossbreds BxA (12.3 *vs.* 14.7 ng/ml) and BxT (12.3 *vs.* 13.4 ng/ml) by 19.5 and 8.9%, respectively. While, the minimum and maximum values were (2.2 – 25.4), (2.0 – 29.4) and (1.6 – 27.8 ng/ml) for B, BxA and BxT, respectively. And the overall mean was 13.5 ng/ml for all the breeds, the minimum values of leptin was at calving.

Kadokawa *et al.* (2006) found that the concentration of plasma leptin in early (on day 14) postpartum Holstein cows was 0.73 ng/ml and they observed that the range of minimum and maximum values were 0.54–1.12 ng/ml. They mentioned that the relationship between leptin concentrations and energy balance was poor (P<0.10), but leptin concentrations correlated negatively with milk fat content.

Table 3. Blood insulin like growth factor (IGF-1, ng/ml) and leptin (ng/ml) (LSM±SE) in Baladi and their crossbreds with Abondance (BxA) and Tarentaise (BxT).

Items	IGF-1	Leptin
B	$143.3^{b}\pm24.02$ (134.4-217.9)	$12.27^{b}\pm1.3$ (2.2-25.4)
B x A	$195.8^{b}\pm19.14$ (93.4-292.8)	$14.7^{a}\pm1.27$ (2.0-29.5)
B x T	$239.2^{a}\pm23.39$ (118.03-350.5)	$13.4^{b}\pm1.01$ (1.6-27.8)

Means having different superscript letters within the same column differ significantly (P<0.05). Between parentheses is the range.

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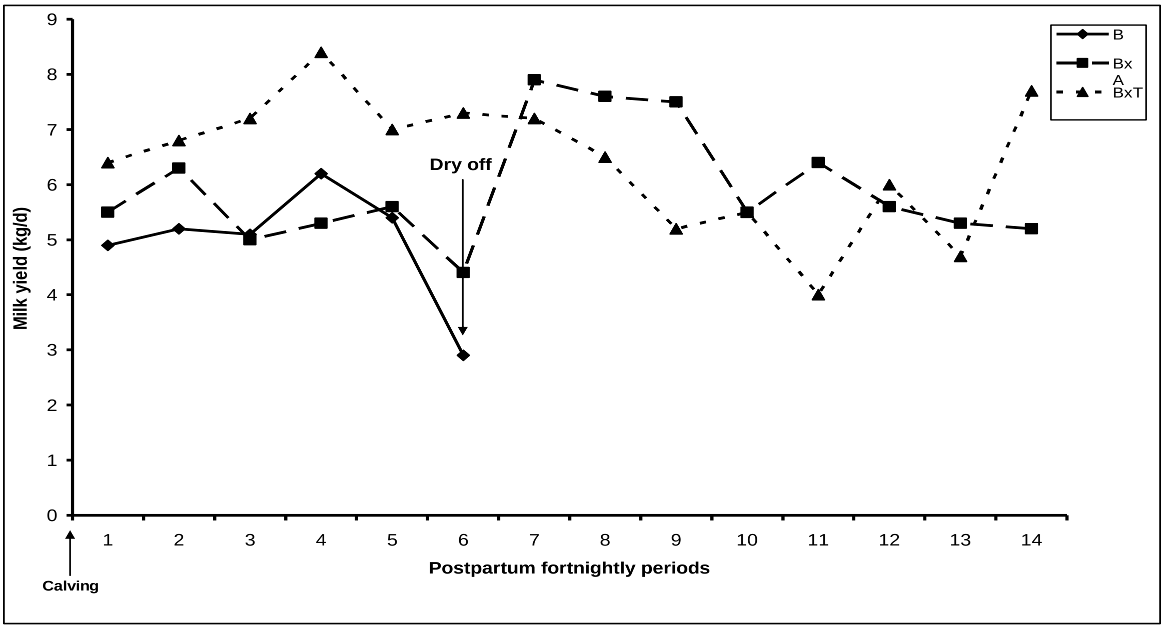

Fig. 1. Changes in average daily milk yield (kg/d) throughout the experimental period in primiparous Baladi cows (B) and their crossbreds with Abondance (AxB) and Tarentaise (TxB)

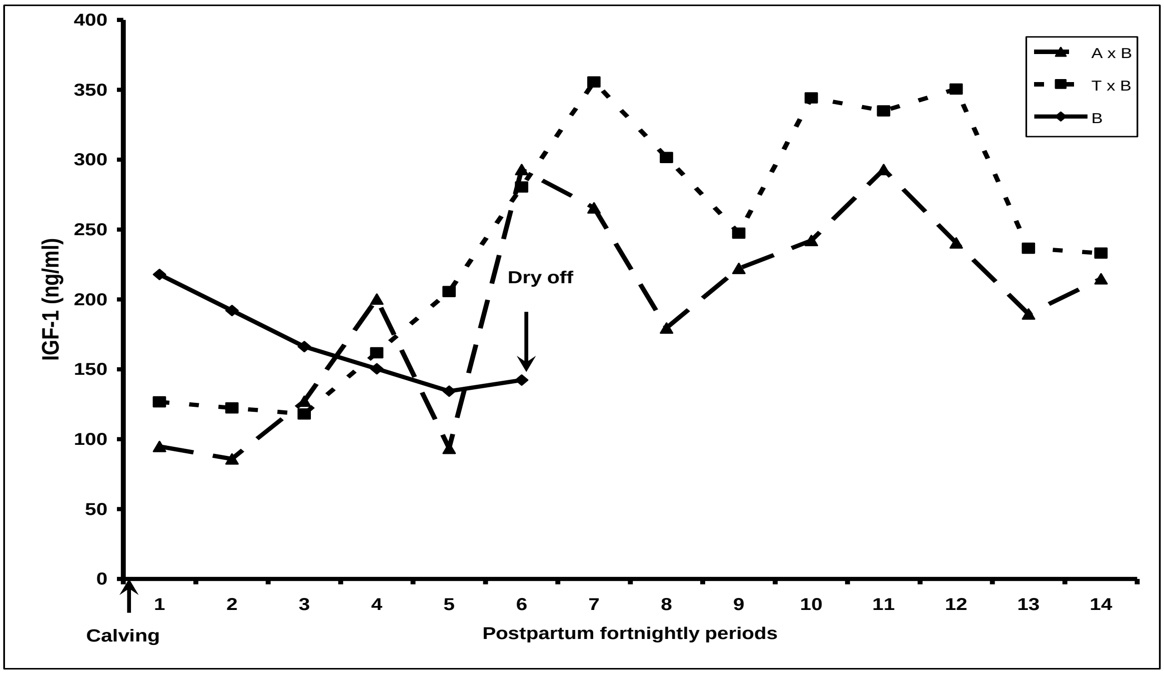

Fig 2. Changes in serum IGF-1 (ng/dl) throughout the experimental period in primiparous Baladi cows (B) and their crossbreds with Abondance (AxB) and Tarentaise (TxB)

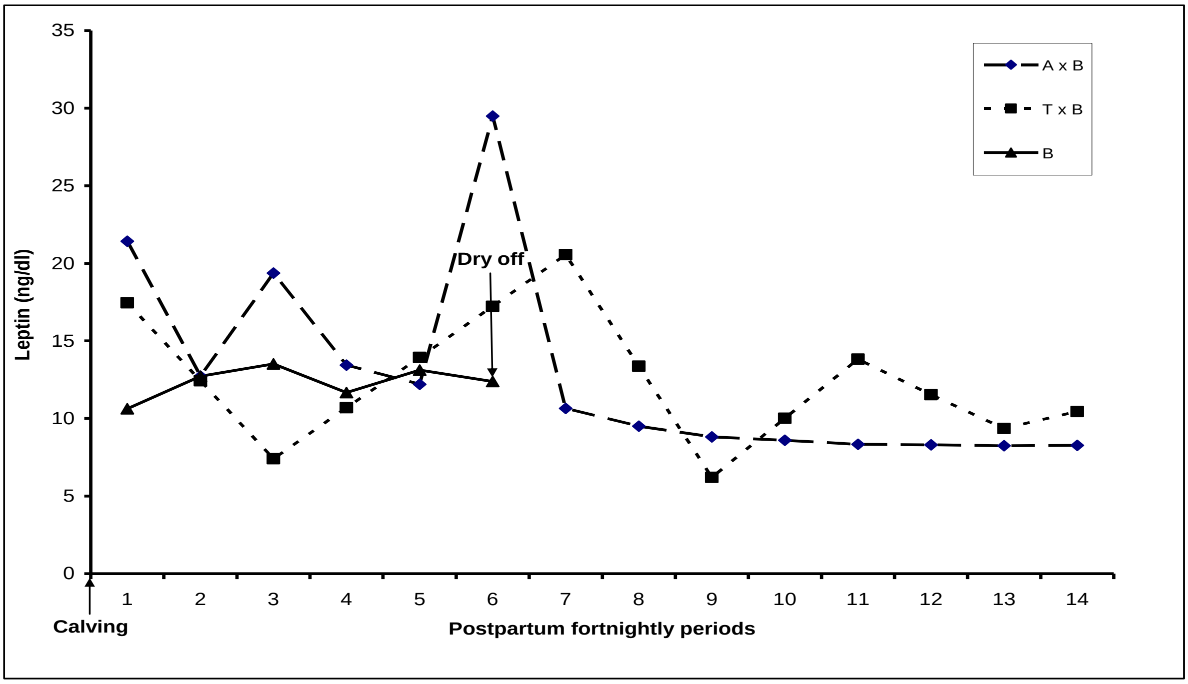

Fig 3. Changes in serum leptin (ng/dl) throughout the experimental period in primiparous Baladi cows (B) and their crossbreds with Abondance (AxB) and Tarentaise (TxB)