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The Correlation Between the Age of Puberty and Biochemical Metabolite, ALP, Body Weight And Body Condition Score in Iraqi Holstein Cross Breed.

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ABSTRACT

This study was conducted in the animal's farm in college of agriculture / Tikrit University, during the period from February to august 2014. Ten Iraqi cross breed Holstein heifers were used for detect the age of puberty and relationship between this ages with body weight and body condition score. In addition some biochemical metabolite (cholesterol, glucose, total protein and triglyceride) and alkaline phosphatase (ALP) were tested using spectrophotometer and estimated the correlation with the age of puberty. All above parameters were estimated biweekly until puberty. Puberty was defined as the 1st ovulation achievement by using Trans-rectal the ultrasound technique which performed every other day. The result of the current study illustrated that age of puberty in Iraqi cross breed Holstein depending on proven by the occurrence of the first ovulation was 4.72 ± 48.4 week at mean value of body weight (BW kg) 234.60 ± 11.14 kg and BCS 2.65 ±0.10. There was significant correlation ($p<0.05$) between age of puberty and mean body weight and body condition score. The glucose concentration did not change significantly with the increasing animal age, whereas the triglyceride concentration was decreasing as the animal approaches puberty. The concentration of cholesterol, total protein and ALP were increasing as the animals approach puberty age. The present study demonstrated a significant correlation ($p<0.05$) between the age of puberty with the concentration of total protein and ALP only.

KEYWORDS

Introduction:

Puberty is defined in both male and female as the ability to accomplish reproduction successfully[1]. In particular, age at puberty has an important impact on the reproductive and economic efficiency of the herd and during the productive life of the cow[2]. Average Age at puberty varies greatly, ranging from approximately (8 – 24) month. It's important to emphysize that age at puberty is profoundly influenced by deferent other factors (genetics and breed, body weight (BW), and rate of body weight gain, body composition, plane of nutrition etc.)[3]. The blood biochemical metabolites such as glucose, total proteins, triglyceride and cholesterol may considers important signals that are closely linked with puberty in cattle[4]. The age of puberty and this relation with the body weight , BCS, biochemical metabolite and enzyme were estimated in different cattle breed by several authors[4,5,6], but there is little information has been reported about Iraqi Holstein cross breed heifers therefore the present study was under taken to investigate the age of puberty in Iraqi Holstein cross breed and the relationships of this age with the body weight, BCS, ALP and biochemical metabolite (cholesterol, glucose, total protein and Triglyceride).

Material and Methods:

This study was conducted at the Animal Farm, Agriculture College/ University of Tikrit during the period from February to August 2014. This experiment included ten Iraqi cross breed Holstein heifers aged 6-7 months old and an average body weight of 85-100 kg. The animals were daily fed on a balanced diet of grains. This experiment was undertaken to detect the age of puberty by using Linear – array intra -rectal transducer of real time B mode with 7.5 MHz (BMD-3000VET, BIOMED, USA). Ultrasound examination of the ovaries was done every other day from the beginning of the present study and continuously to the first ovulation (puberty).

Determination of body weight of experimental heifers during the present study were done by using electronic scale for large animals biweekly since the beginning of the experiment until puberty. In the current study, Body condition scores of the heifers were estimated by visual scoring. A 6-point grid (0 = extremely thin to 5 = extremely fat cows)[7]. Blood samples (10 mL) from six animals were collected biweekly throughout the prepubertal period and for at least 4 weeks after onset of puberty via jugular venipuncture at 7.00 AM. Samples were collected via vacutainer tube without anticoagulant. Samples were allowed to clot for 20 minute at room temperature, after that they kept in refrigerator at (5 c) for 24 hrs. Serum decanted following immediate centrifugation of the samples (3000 RPM for 15 minutes) and stored under -20 C until analyzed. All biochemicall metabolite and ALP[8] were determined with an enzymatic colorimetric procedure by special kit provided by Biolabo, France. The Statistical Analysis System- SAS (2012) was used to show the effect of different factors on study parameters. Least significant difference –LSD test was used to compare between means in this study. Estimate of correlation coefficients between some parameters were studied.

Results:

The present study revealed that the age of puberty in Iraqi Holstein cross breed heifers was 48.4 ± 4.72 weeks, documented with occurrence of first ovulation by using trans-rectal ultrasonography image. It was recorded that the mean value of BCS 2.65 ±0.10 and body weight (BW kg) 234.60 ± 11.14 kg at the age of puberty. The increasing of body weight showed continuous increasing throughout the experiment till puberty achieved Fig. (1). Furthermore the present experiment found highly significant ($P<0.01$) correlation between these parameters and age of puberty Tab (1).

The mean value of cholesterol concentration at age of puberty was 158.28±13.12 mg/100ml Tab (2). The concentration of cholesterol increased gradually with the progressing of the age of experimental heifers until last week (52 week) of this study, Regarding glucose concentration, the result of this study revealed that the mean value of glucose concentration at puberty reached 74.86 ± 3.19 mg/100ml Tab (2). The concentration was not constant all over the period of

this experiment, the present results showed significant elevation (P<0.05) of glucose concentration at 34, 48 -52 weeks in comparison with 1st week of the study. Total protein concentration at the age of puberty was 8.96±0.48 g/100ml. Concentration of total protein was not constant, a significant rising (p<0.05) noticed between 1st week (28) and the last three weeks (48, 50 and 52) of experiment period. The result obtained from Tab (3) indicated that there was a significant (P<0.05) correlation (r= -0.17) between the age of puberty and total protein concentration. The mean value of triglyceride was 2.44±1095 mmol/L at the age of puberty. In this regard a significant rise (P <0.05) in mean Triglyceride concentration was observed at 36 week compared to 28 and 52 weeks of this study. The mean value of ALP at age of puberty during this study was 14.17 ±0.61 U/100ml. Significant elevation (p<0.05) in mean ALP concentration was obvious at 34, 36 and 42 weeks in compared with the 28 – 32 weeks during observational period. Statistical analysis of the result exhibited that there was a significant (p<0.05) negative correlation (r= -0.21) between the concentration of ALP and the age of puberty Tab (3).

Discussion:

Iraqi Holstein cross breed heifers in the present study reached puberty at 48.4 ± 4.72 weeks of age with body weight 234.60 ± 11.14 kg Tab. (1). These findings were coincided with[9] (48 week) in pure-breed Holstein heifers and near with result of [3] (46 week) in pure-breed Jersey heifers, while the experimental cross breed had a longer pubertal age compared with other studies [10] in Angus x Simmental cross breed (32 weeks), [9] in Jersey Holstein cross breed (42 weeks). Holstein cross breed heifers had a younger puberty age (12 months) compared to (20 months) in Iraqi local breed (sharabi) [11] and (23 months) in Brahman cattle [12] and Nellore heifers [13]. This dissimilarity among studies may attribute to the influence of genetics and breed [14] and heterosis [10] on the age of puberty.

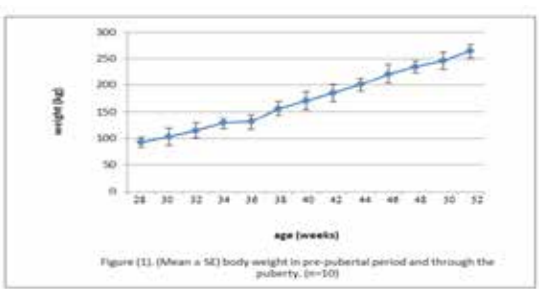

Figure (1). (Mean ± SE) body weight in pre-pubertal period and through the puberty. (n=10)

Table (1): Correlation coefficient between puberty and BSC, BW & Pelvic outlet and inlet (n=10)

Parameters		Correlation coefficient (r)	Level of sig.
Puberty	BSC	-0.49	**
	BW	-0.28	**
** (P<0.01).			

Table (2): Concentration (mean ± S.E) of cholesterol, Glucose, TP, Triglyceride and ALP through 1the achievement of puberty (n=6).

Parameters Age (week)	Cholesterol Mg/100ml	Glucose Mg/100ml	TP g/100ml	Triglyceride Mmol/L	ALP U/100ml
28	96.76±6.72 a	53.23±2.70 a	6.47±0.37 a	0.33±0.024 a	12.35±0.39 a
30	93.57±12.97 a	55.91±2.06 ab	7.07±0.19 ac	0.40±0.053 ab	12.26±0.41 a
32	129.94±13.36 ab	63.57±6.31 ab	7.72±0.23 ab	0.42±0.052 ab	12.20±0.50 a
34	131.78±10.41 ab	76.87±6.49 b	8.17±0.34 ab	0.51±0.049 ab	17.03±1.05 b
36	134.25±11.31 ab	66.62±6.72 ab	8.62±0.38 ab	0.56±0.086 b	17.00±0.43 b
38	128.23±10.00 ab	60.08±2.74 ab	7.91±0.27 ab	0.71±0.098 bc	13.7±1.24 ab
40	141.29±9.16 ab	62.79±2.94 ab	8.41±0.29 ab	0.60±0.071 ab	15.38±0.57 ab
42	161.16±11.58 b	64.13±3.38 ab	8.21±0.40 ab	0.59±0.068 ab	17.08±0.75 b
44	152.87±10.86 ab	69.01±2.14 ab	8.65±0.49 ab	0.55±0.058 ab	16.01±0.57 ab
46	149.49±14.21 ab	73.62±4.01 ab	8.65±0.52 ab	0.53±0.044 ab	14.01±0.92 ab
*48	158.28±13.12 ab	74.86±3.19 b	8.96±0.48 bc	0.48±0.037 ab	14.17±0.61 ab
50	165.7±11.55 b	76.18±3.84 b	9.2±0.48 b	0.42±0.011 ab	13.74±0.47 ab
52	167.83±11.25 b	76.6±3.59 b	9.51±0.50 b	0.37±0.019 ac	13.91±0.41 ab

Different litters between raw mean significant variation (P<0.05)

(*)Mean age at puberty was 48.4±4.72 weeks.

Table (3): Correlation coefficient between age of puberty and Cholesterol, Glucose, Total protein, ALP & Triglyceride (n=6).

Parameters		Correlation coefficient (r)	Level of sig.
Puberty	Cholesterol	-0.06	NS
	Glucose	0.01	NS
	Total protein	-0.17	*
	Triglyceride	-0.07	NS
	ALP	-0.21	*
* (P<0.05), NS: Non-significant.			

Body weight (BW kg) of Iraqi cross breed Holstein at age of puberty was (234.60 ± 11.14 kg) Tab. (1), in compared with gradual increasing of BW at puberty in the other researches (238 ± 15.5 kg) in Hereford Angus cross breed [15], (241.8 ± 9.5 kg) in Jersey cross breed heifers [3], while when compared the BW of experimental heifers (234.60 ± 11.14 kg) with pure Jersey heifers(192.7 ± 19.0 kg) observed them heavier[3]. These differences in these results may attributed to the feed intake and plane nutrition which positively associated with body gain [16], and hastened onset of puberty. The current study showed a high correlation (r = -0.28) Tab. (3) between age of puberty and heifers BW. This is in accordance with observation of [1]. The mean value of BCSs at puberty during the present study was (2.65 ±0.10) Tab. (1), this result coincided with study of [3] in Holstein, Jersey and Jersey cross breed 2.62 ± 0.04. The present experiment found that BCS was highly related to the age of puberty, this finding is accordance with [17], the high correlation between the BCS and age of puberty during this study suggests that the heifers attaint puberty earlier at higher scores of BCS, to take into cosideration an association between fat deposition and onset of puberty [18].

One of the objectives of this study was to illustrate indices of some metabolites (cholesterol, glucose, triglyceride and total protein) and some enzymes (ALP) on the onset of puberty in Iraqi cross breed Holstein heifers. There is convincing evidence that serum levels of cholesterol have an association to metabolic status and to the activity of reproductive process [6]. In addition, cholesterol is considered a precursor of steroidal hormones and plays an important role in the steroidogenic pathway which is required to enhance follicular growth

and development at ovarian level and process of ovulation [19]. During the present experiment, the increasing of cholesterol concentration was preceding the onset of puberty, this result consistent with observations reported by [20]. [21] attributed these information to the fact that cholesterol act, as the main precursor of steroidal hormones later involved in the activation of follicular growth and ovulation when the puberty attainment. The present study did not show any significant correlation between the cholesterol and age of puberty in contrary to the results of [22] who noticed a moderate negative correlations (correlation coefficient:-0.4- -0.7) between the age and cholesterol concentration in dogs. The mean value of glucose concentration at puberty in this experiment heifers reached 74.86 ± 3.19 mg/100ml Tab (2). Similar result was obtained by [23] (73.21+3.12 mg/100ml) in Brangus heifers and slightly more in study of [5] (81.68±3.25 mg/100ml) in Friesian heifers. The present study revealed a significant elevation (P<0.05) of glucose concentrations with approaching and after puberty, this result is agreement with the finding of [24,5]. While it was not correspond with the findings of [25] who mentioned that the concentration of glucose decreased with the animal age approaching. This difference may perhaps be related to the type of breed and/ or nutritional status [26]. The mean value of total protein concentration in our experiment heifers was 8.96±0.48 g/100ml at the age of puberty Tab (2). A slightly higher result were obtained by [27] (7.13+0.36 g/100ml) in Italian Holstein-Friesian heifers. The present study had showed that there is an inverse correlation (P>0.05) between the level of Total protein and age at puberty in experimental heifers, this result coincided with other work [28,29]. [30] attributed the significant differences in the serum protein concentration between pubertal and mature Angoni cattle were due to longer exposure to various antigens or pathogens and production of antibodies. The mean value of triglyceride was 2.44±1095 mmol/L at the age of puberty in the current experiment heifers Tab (2). Triglyceride concentration in the present experiment exhibited curvilinear profiles relative to the onset of puberty, furthermore the current study revealed negative correlation between Triglyceride and age of puberty Tab.(3), these results reversed with those obtained by [31] who recognized a significant decreases in the triglyceride concentration with goat age progression. In contrast to the results of the present study [22]recorded moderate positive correlations between the age and TG in dogs and a significant (p=<0.05) correlation between the progression Torkman horses age and triglyceride concentration [32]. The present study recorded that the mean value of ALP at age of puberty was 14.17 ±0.61 IU/100ml Tab. (2). Similar result was found by [27] (14.75+0.41 IU/100ml) in Italian Holstein-Friesian heifers. A clear relationship has been reported among ALP and the age of puberty [26], similar results were obtained in the present study Tab.(3), The present study recorded the increasing of ALP concentration before approaching of puberty, this agreement with work of [29], who found that ALP increased with age during the entire experiment.

Conclusions:

Iraqi cross breed Holstein cattle reached puberty at age of 48.4 ± 4.72 weeks and their mean body weight was 234.60 ± 11.14 kg. There were reversal correlation between the age of puberty and BCS and Body weight. Some metabolites (cholesterol, glucose, total protein and triglyceride) reflect nutritional status of the animals but total protein was the more precise one as an indicator for the approaching of puberty in cattle.

REFERENCES

1. Ahmadzadeh A.; Carnahan K. and Autran C., (2011). Understanding Puberty and Postpartum Anestrus. Proceedings, Applied Reproductive Strategies in Beef Cattle, Pak. Vet. J. 23:42-55. | 2. Maquivar M.; Souto L.A., Grm D.E.; Hallford D.M.; Loerch S.C.; Pires A.V. and Day M.L., (2009). Effect of diet composition on precocious puberty and concentrations of IGF-I in beef heifers. J. Anim. Sci. 87: E-Suppl. 2: 322. | 3. Williams C. M., (2007). Effects of Crossbreeding on Puberty, Postpartum Cyclicity, and Fertility in Pasture-Based Dairy Cattle. MSc. Thesis, North Carolina State University. | 4. Acuti G.; Todini L.; Malfatti A.; Antonini M.; Barbato O. and Trabalza-Marinucci M., (2009). Effects of field bean (Vicia faba L. var. minor) dietary supplementation on plasma thyroid hormones, insulin, insulin-like growth factor-1 concentrations and mohair characteristics in growing Angora goat kids. J. An. Phys. An. Nutr., 93: 456-466. | 5. Gabr Sh. A., (2013). Effect of rbST Administration on Pubertal Age and Some Blood Parameters in Friesian Heifers. Egyptian J. Anim. Prod. 50(3):122 -131. | 6. Meza-Herreraa C.A.; Calderón-Leyvaa G.; Soto-Sancheza M.J.; Serradillab J.M.; García-Martinezb A.; Melladoc M. and Veliz-Deras F.G., (2014). Glutamate supply positively affects serum cholesterolconcentrations without increases in total protein and ureaaround the onset of puberty in goats. Animal Reproduction Science 147: 106–111. | 7. Ezanno P.; Alexandre I. and François B., (2003). Factors affecting the body condition score of N'Dama cows under extensive range management in Southern Senegal . Anim. Res. 52: 37–48. | 8. Ashwood A., (2012). Reproduction- Oestrus and Puberty Brahman News. Technical Information– Reproduction. J. Reprod. Fertil. 122:133-155. | 9. Getzewich, K.E., (2005). Hormonal regulation of the onset of puberty in purebred and crossbred Holstein and Jersey heifers. J. Anim. Sci. 25:135–139. | 10. Maquivar M.G., (2011). Nutritional Regu;ation of Precious Puberty in Hheifers. PhD Thesis. The Ohio State University. | 11. Haddad, A.A.M. (1981). Comparative study for milk production and reproductive efficiency in Sharabi and Friesian imported cattle under the environment condition of the northern region of Iraq. Master Thesis. College of Agriculture and Forestry/University of Mosul. | 12. Samadi R.; Nathan R.; Miller b.; Hassan M.; Chris H.; Hiroshi K. and Nargess Sh., (2014). Origin of garnet in aplite and pegmatite from Khajeh Morad in northeastern Iran: A major, trace element, and oxygen isotope approach. Lithos 208–209, 378–392. | 13. Monteiro F.M.; Mercadante M.E.Z.; Barros C.M.; Satrapa R.A.; Silva J.A.V.; Oliveira L.Z.; Saraiva N.Z.; Oliveira C.S. and Garcia J.M., (2013). Reproductive tract development and puberty in two lines of Nellore heifers selected for postweaning weight, Theriogenology, 80, 10–17 | 14. Sartori R.; Bastos M.R.; Baruselli P.S.; Gimenes L.U.; Ereno R.L. and Barros C.M., (2010), Physiological differences and implications to reproductive management of Bos taurus and Bos indicus cattle in a tropical environment. Botucatu, SP, Brazil, 18618-000. | 15. Daivis M.P., (2006). Effects of Direct Fed Microbials on Concentrations of Glucose and Insulin in Plasma and Animal Performance. MCs Thesis. University of Missouri Columbia, MO. | 16. Donato, J.J.; Cravo, R.M.; Frazao, R. and Elias, C.F. (2011). Hypothalamis sites of leptin action linking metabolism and reproduction. Neuroendo., 93: 9 – 18. | 17. Taylor V.J.; Cheng Z.; Pushpakumara P.G.; Beever D.E. and Wathes D.C., (2004). Relationships between the plasma concentrations of insulin-like growth factor-1 in dairy cows and their fertility and milk yield. Vet Rec;155:583–8. | 18. Baptiste Q.S., (2002). The Effects of Diet and Weight on Induction of Ppuberty and Fertility Response in Yearling Beef Heifers. MCs Thesis. Davis College of Agriculture, Forestry, and Consumer Sciences at West Virginia University | 19. Gimpl G. and Gehring-Burger K., (2007). Cholesterol reporter molecules.Biosci. Rep. 27, 335–358. | 20. Kapale P. M.; Jagtap D. G.; Badukale D. M. and Sahatpure S.K., (2008). Serum total proteins and serum total cholesterol levels in Gaolao Cattle. Veterinary World, Vol.1(4): 115-116. | 21. Meza-Herrera C.A., (2012). Puberty, kisspeptin and glutamate: a ceaselessgolden braid. In: Benhardt, L.V. (Ed.), Adv. Med. Biol., 52. Nova SciencePublishers, NY, USA, pp. 97–124, 3. | 22. Kawasumi K.; Nanae K.; Yuki O.; Masaki S.; Yasuhiro S.; Eiji I.; Nobuko M.; Ichiro Y. and Toshiro A., (2014) . Age effects on plasma cholesterol and triglyceride profiles and metabolite concentrations in dogs. BMC Vet. Res., 10:57. | 23. Shirley K.L.; THomas M. G.; Keisler D. H.; Hallford D. M.; Montrose D. M.; Silver G. A. and Garcia M. D., (2006). CASE STUDY: A Chihuahuan Desert Brangus Breeding Program: Feed Efficiency, Metabolic Hormones, and Puberty in Heifers Sired by Bulls with Differing Expected Progeny Differences for Growth and Scrotal Circumference. The Professional Animal Scientist 22:48–58. | 24. Jones E. J.; Armstrong J. D. and Harvey R. W., (1991). Changes in metabolites, metabolic hormones, and luteinizing hormone before puberty in Angus, Braford, Charolais, and Simmental heifers. J ANIM SCI, 69:1607-1615. | 25. Cabaraux J. F.; Dufrasne I.; Istasse L.and Hornick J. L., (2004). Effects of age on plasma metabolites and hormones in finishing Belgian Blue double-muscled cull females. Animal Science, vol. 78, p. 229-235. | 26. Otto F.; Vilela F.; Harun M.; Taylor G.; Baggasse P. and Bogin E., (2000). Biochemical Blood Profile of Angoni Cattle in Mozambique. Isr. J. Vet. Med. v.55 (3). | 27. Abeni, F.; Calamari, L.; Stefanini, L. and Pirlo, G. (2000). Effects of Daily Gain in Pre- and Postpubertal Replacement Dairy Heifers on Body Condition Score, Body Size, Metabolic Profile, and Future Milk Production. J. Dairy. Sci. 83: 1468-1478.Bogin, E., (1994). Handbook for Veterinary Clinical Chemistry. Kodak Publ. USA. | 28. Sargentini C.; Bozzi R.; Rivera P. D.; Giorgetti A.; Martini A.; Lupi P.; Cazzola P.L.; Beltempo S. and Carelli T., (2007). Onset of puberty in Maremmana heifers. Ital. J. Anim. Sci. Vol. 6, 385-394. | 29. Pavlik A., (2009). Changes of internal environment indicat ors of Aberdeen Angus heifers during rearing. Slovak J. Anim. Sci., 1: 76-80. | 30. Kaneko J.J.; Harvey J.W. and Bruss M.L., (1997): Clinical Biochemistry of Domestic Animals. Acad. Press, New York. | 31. Nazifi S.; Hamid R.G. and Farjad S., (2002). Serum lipids and lipoproteins and their correlations with thyroid hormones in clinically healthy goats. VETERINARSKI ARHIV 72 (5), 249-257. | 32. Nazifi S.; Saeb M. and Abedi M., (2003). Serum Lipid Profile and their Correlation with Thyroid Hormones in Clinically Healthy Turkoman Horses. Comp. Clin. Path., 12: 49-52.