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Short Communication

Comparison of some metabolites in blood and ovarian follicular fluid in different sizes in Holstein dairy cows

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Abstract

Follicular fluid biochemical compounds are influenced by their corresponding serum metabolites. In this study, 45 non-pregnant Holstein cows were selected and divided into three categories (small, medium and large). Blood samples were taken before slaughter from tail vein. Glucose, urea and insulin were measured in serum and follicular fluid. The results showed that by increasing the size of the follicles, glucose and insulin concentration increased significantly ($P<0.05$), however, urea concentration significantly ($P<0.05$) reduced in follicular fluid. In general, these result showed the existence of significant relation between the follicular size and concentration of these metabolites is a useful indicator to realize their role in growth and maturation of Oocytes.

Keywords: Follicle; ovarian; follicular fluid; serum

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Introduction

One of the most important reasons for the removing dairy cattle is reproductive abnormalities and fertility reduction that impose large costs on livestock. Ovarian cycle refers to the set of processes that occurs in frequently manner in the ovary of non-pregnant adult animals. Ovarian cycle consists of two phases, the follicular phase, is the phase of follicular growth with ovulation period, and luteal phase is the period of corpus luteum development with its recession. During the follicular growth levels, follicular fluid contains growth factors, hormones and nutrients which provide the necessary conditions for the growth and maturation of oocytes. Studies have shown that many hormones and metabolites such as glucose, insulin, non-esterified fatty acids and insulin-like growth factor affect ovarian activity, biosynthesis of steroid hormones and oocyte growth. Cellular studies have demonstrated that granulosa cells as germinal ovarian cells are associated with the production and gene expression of IGF-1. These hormones and gonadotropins can stimulate the growth of ovarian follicles (Landau et al., 2000).

Follicular fluid reflects the biochemical and hormonal activities (Zamiri, 2006). The ability of oocytes maturation and growth in cattle is affected by follicle size and follicular fluid, changes in the metabolic activity and biochemical composition (Thatcher et al., 2004). The source of the composition of follicular fluid is serum, so the growth and maturation of the follicle and finally ovulation is affected by the concentration of blood metabolites (Fortune et al., 2004). Changes in blood biochemical compounds is one of the important indicators of physiological conditions in animals and serum metabolic changes may influence the follicular fluid biochemical composition and indirectly influence the development of the oocyte. The present study was

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Table 1: Concentration of different metabolites in serum and follicular fluid in Holstein cows

Treatment	Serum urea (mg/dl)	Follicular fluid urea (mg/dl)	Serum insulin (mg/dl)	Follicular fluid (mg/dl) insulin	Serum glucose (mg/dl)	Follicular fluid glucose (mg/dl)
Small follicle (smaller than8mm)	38.16±6.01	28.25±0.66 □	1.7±0.2 □	0.86 ±0.08	95.58±1.80 [c]	6.41±1.98 [c]
Average follicle (15-8mm)	36.38±8.40	24.535±0.2 [b]	1.8±0.3□	1.03±0.18	97.30±1.33□	7.53±0.60 [b]
Large follicle (25-15mm)	34.38±7.93	22.694±0.38 □	2.19±0.3 □	1.07± 0.21	111.61±1.6 [a]	9.84±0.10 [a]

Mean value with different superscripts in each column differ significantly (P<0.05).

performed to determine the concentration of glucose, urea and insulin in ovarian follicular fluid of different sizes as well as serum in Holstein dairy cows.

Materials and Methods

In this study, 45 Holstein non-pregnant dairy cows with no reproductive disease were selected. About 10 ml of blood samples from the tail vein prior to slaughter were obtained. Serum was separated from blood and kept at -20ºC until analysis. After slaughtering, ovaries were removed and collected in plastic bags and immediately transported to the laboratory. Follicular size was measured with a digital calliper. Follicles were divided into small (less than 8 mm), medium (8-15 mm) and large (15-25mm) size. Follicular fluids of each group was separated with the help of insulin syringe and poured into micro-tubes and kept at -20ºC. Glucose, urea and insulin in serum and follicular fluid were determined by using lab kits (Pars Amazon, Iran) with the help of spectrophotometer (Pharmacia, Model Nova Space, England). Data were analyzed using the SAS 9.0 (2002) software. Means were compared using ANOVA. Difference between the means was assessed at 1% level by Tukey Kramer.

Results and Discussion

The result of serum and follicular fluid concentration is given in Table 1. In this research, there was an inverse relationship between the size of the follicle and urea concentration of follicular fluid. Urea concentration of follicular fluid significantly (P<5%) reduced with increasing size of the follicle. In this case, the result agreed with findings of Nandi et al. (2007) and Leroy et al. (2004) who found that urea concentration in various follicular sizes was reduced by increasing follicles sizes. On the other hand, Tabatabai et al. (2011) showed a uniform concentration of urea during the follicular growth. Quality of the growing oocyte is affected by high urea concentration and the excess amount of urea in the follicular fluid disrupts the formation of the blastocyst (Leroy et al., 2004). Also in this study glucose concentration increased with increasing size of the follicle. Glucose is one of the main metabolites in the ovary metabolism. Glucose is also the main source of energy and produces energy (Iwata et al., 2004). Studies in various species have shown that glucose levels in follicular fluid increases with increasing size of the follicle (Leroy et al., 2004). Some studies have shown that glucose level in cystic follicles is relatively low in follicles ready to spawn (Thatcher et al., 2004; Leroy et al., 2004). Reason of the high concentration of glucose in the large follicles is likely due to the higher metabolism of glucose than small follicles.

Furthermore, in this study it was found that serum insulin concentration increased significantly in the cows with increasing follicle size. Insulin is important as metabolic signals for the resumption of local cycle in dairy cows after calving (Butler et al., 2004). Numerous studies have shown that insulin is involved in the ovulation of follicle (Spicer et al., 1993; Walters et al., 2006). Follicular cyst formation in high producing cows is associated with low levels of serum insulin (Vanholder et al., 2005). The results of this study and the previous reports (Leroy et al., 2004; Thatcher et al., 2004; Zamiri, 2006) indicated that glucose, insulin and urea concentration during follicular growth varies with the size of the follicle. In general, characterization of biochemical substances provides a back ground for growth and maturation of oocyte for optimal reproduction.

Conclusion

The results of this study indicated that concentration of glucose and insulin is increasing with increasing the size of the follicle while urea is decreasing. A significant correlation between the follicular size and these metabolites is helpful to understand their role in the growth and maturation of oocyte.

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