

Chemical components of aqueous humor in Korean native cattle and Holstein-friesian cattle

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한우 및 젖소 전방수의 화학조성

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초 록 : 가축 특히 대동물에 있어서 전방수의 화학조성에 관한 보고는 극히 드물다. 따라서 본 연구에서는 한우 및 유우(Holstein)를 대상으로 전방수에 대해 화학조성을 검토하였다. 유의 의 protein, urea nitrogen, creatinine, cholesterol, calcium, sodium, potassium과 chloride 등이 분석 검출되었다. 이러한 조성분포는 혈장에서 보다는 수액(cerebrospinal fluid)의 조성에 더 유사한 것으로 나타났으며, 한우 및 유우에 있어서 조성에 관한 차이는 거의 인정되지 않았다.

Key words : aqueous humor, chemical components, cattle.

The main roles of aqueous humor are to act as a carrier for nutrients to the cornea and lens, to remove waste products from the interior of the eye, and to maintain intraocular pressure¹. It has been suggested that the chemical composition of aqueous humor may be a critical indicator for the estimation of ocular toxicity of drugs or for the metabolic capacity of bioactive molecules in the interior chamber of eye^{2,3}. Recent studies have indicated that many chemical agents such as ketamine-xylazine⁴, dexamethasone⁵, formaldehyde⁶ or ouabain³ can damage the biochemical formation of aqueous humor components. It has been also reported that the level of some

components such as protein and glutathione can be altered in glaucoma⁷. In addition, pharmacokinetic analysis relating to distribution of therapeutic agents in aqueous humor have been also attempted using laboratory animals^{8,9}. Although the studies concerning the aqueous humor have been extensively carried out in humans and some laboratory animals including rabbits and monkeys, they are rare in domestic animals. In this study, the chemical composition of bovine aqueous humor in Korean native cattle and Holstein-Friesian cattle was studied, and the chemical values were compared with that of other species obtained from literature.

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Aqueous humor was collected directly from the anterior chamber of cattle(5-7 year old) when the hosts were slaughtered. Each sample was immediately frozen in a dry-ice chamber and stored in -80°C biofreezer until analysis. Aqueous humor samples were thawed at room temperature and were centrifuged at 3000rpm for 10 min(Centrifuge II-15, Sigma). After filtration, the filtrates were subjected to the biochemical analysis. Total protein, urea nitrogen, creatinine, glucose, total cholesterol and calcium were determined using a biochemical autoanalyzer (JCA VX-1000, Jeol Co.). Sodium and potassium were analyzed using a flame photometer(IL943, Instrumental Laboratory), and chloride using a chloridimeter(C-200AP, Jookoo Co.). Specific gravity of bovine aqueous humor was determined using a colorimetric strip(Multistix, Ames).

Chemical components of bovine aqueous humor are summarized in Table 1. The average levels of total protein, urea nitrogen and glucose were observed to be approximately 80mg/dl, 10mg/dl and 60mg/dl, respectively. Small amount of creatinine and cholesterol were also detected at the levels of 0.4-0.6mg/dl. The levels of sodium and chloride were 110-140mmol/l and calcium and potassium were approximately 4mmol/l. These chemical values showed no statistically significant differences, except for sodium, between the two breeds, Korean natives and Holsteins.

Table 1. Chemical composition of the aqueous humor of cattle

Components	Korean natives(n=5)	Holsteins(n=5)
Total protein(mg/dl)	80.2±29.0	80.0±17.1
Urea nitrogen(mg/dl)	10.4±0.41	10.5±0.37
Creatinine(mg/dl)	0.45±0.02	0.42±0.01
Glucose(mg/dl)	61.7±6.19	55.6±7.80
Total cholesterol(mg/dl)	0.44±0.22	0.38±0.17
Calcium(mg/dl)	4.64±0.15	4.44±0.18
Sodium(mmol/l)	120±6.10	141±2.49*
Potassium(mmol/l)	3.69±0.16	4.02±0.17
Chloride(mmol/l)	116±1.66	111±3.57
Specific gravity	1.011±0.002	1.010±0.002

The values are mean±SE. Statistical analysis was performed by the Student's t-test for the comparison of two breeds(p < 0.05).

Chemical compositions in the serum or cerebrospinal fluids of cattle have been well documented by many earlier investigators¹⁰. Comparing the values in aqueous

humor with those in plasma from literature^{11,12}, protein and cholesterol in the anterior chamber were found much lower levels than in plasma(1.0-1.4% in protein and 0.2-0.5% in cholesterol). Creatinine in aqueous humor was lower than that in plasma by approximately 40%, but other organic constituents including urea nitrogen, glucose, calcium and electrolytes were similar to those in plasma. On the other hand, compared with reference values of cerebrospinal fluids¹⁰, there were no significant differences in most values between those of aqueous humor and those of cerebrospinal fluids. Therefore, it may be suggested that the formation mechanism and systemic functions of aqueous humor are more similar to those of cerebrospinal fluids rather than plasma.

When we compare the levels of aqueous components in cattle with those in other species from the literature, aqueous protein in cattle is significantly higher than that in humans(13.5-23.7mg/dl)^{13,14}, monkeys(33.3mg/dl)¹⁵ and rabbits(25.9mg/dl)¹³, while it is similar to that in rats(100mg/dl)¹⁶. The level of glucose in cattle is similar to that in humans(50.4mg/dl)¹⁷ and monkeys (54.1mg/dl)¹⁵, but lower than that in rabbits(88.3-124mg/dl)^{18,19}, and the level of urea nitrogen is lower than that in monkeys(36.6mg/dl)¹⁵. The level of creatinine in cattle is similar to that in monkeys(0.45mg/dl)¹⁵, while lower than that in rabbits(1.24mg/dl)²⁰. However, other aqueous components including calcium and electrolytes show no significant differences between cattle, rabbits and monkeys^{15,17,21}.

Summary

Chemical components of bovine aqueous humor were analyzed. Significant levels of protein, urea nitrogen, creatinine, cholesterol, calcium and electrolytes including sodium, potassium and chloride were detected. The composition of bovine aqueous humor is similar to that of cerebrospinal fluids, rather than that of plasma. It was also found that there is no significant difference in most components between aqueous humor of Korean native cattle and that of Holstein-Friesian cattle.

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