THE EFFECT OF PHYSIOLOGICAL PARAMETERS ON SERUM LACTATE DEHYDROGENASE ISOENZYMES IN LAMBS

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ABSTRACT


The effect of age, sex and growth rate on total serum lactate dehydrogenase (LDH) and its isoenzymes was assessed in Suffolk X Halfbred lambs from 1.5 days to 10 weeks old. The total LDH activity was higher at 1.5 days than in older lambs and the percentage of LDH₁ tended to increase while LDH₂ and LDH₅ decreased with age from 2 weeks, indicating that the isoenzyme distribution was changing towards the adult pattern. In female lambs, the percentage of LDH₁ was higher than in male lambs at 1.5 days, but little importance was attached to this finding since the difference was not significant at 10 weeks. No clear relationships existed between the level of total LDH or its isoenzymes and daily liveweight gain.

The age-related changes were considered to be of greater significance than those related to sex and growth rate when interpreting serum LDH levels in lambs.

INTRODUCTION

Lactate dehydrogenase (L-lactate:NAD oxidoreductase, EC.1.1.1.27) catalyses the final reaction in the glycolytic pathway under anaerobic conditions (NADH is reduced nicotinamide adenine dinucleotide and NAD⁺ is nicotinamide adenine dinucleotide): pyruvate + NADH + H⁺ → L-lactate + NAD⁺.

The structure of lactate dehydrogenase (LDH) was investigated by Cahn et al. (1962) who showed that the enzyme was a tetramer composed of two subunit types, H and M, which combined to form five isoenzymes - LDH₁ (HHHH), LDH₂ (HHHM), LDH₃ (HMMM), LDH₄ (HHMM) and LDH₅ (MMMM). LDH isoenzymes are not formed by random subunit combination and differences in the proportions of isoenzymes in different organs suggest a physiological basis for their existence. Cahn et al. (1962) proposed that the H and M subunits have different functions. Thus, LDH₄ and LDH₅, which contain mainly M subunits, permit rapid accumulation of lactate and...
are found in tissues such as skeletal muscle, where anaerobic glycolysis pre-
dominates, whereas LDH, and LDH2, containing mainly H subunits, are found in
tissues such as heart, where pyruvate is oxidised via the tricarboxylic acid
cycle. Differences in the predominant metabolic pathways may result in species-
specific isoenzyme patterns in the same tissue and tissue-specific patterns in
the same species. Furthermore, changes may occur in the LDH isoenzyme complement
of the tissues of an individual animal; for example, in the unborn lamb and calf,
liver and heart show an increasing proportion of H subunits and skeletal muscle
an increase in M subunits, with increasing gestational age (Hinks and Masters,
1964). Since enzymes are liberated into the blood during the normal turnover of
cells, it seems likely that tissue isoenzyme levels that are changing as a result
of physiological alterations might be reflected in the serum isoenzymes, but few
studies on the effect of physiological parameters on isoenzymes have been under-
taken in sheep. This paper reports the effect of sex, age and growth rate on the
serum LDH isoenzyme activity of lambs.

MATERIALS AND METHODS

One hundred and twenty-four Suffolk X Halfbred lambs reared under commercial
conditions were used. The ewes were housed before and for a few days following
parturition, after which ewes and lambs were put out to pasture. Individual
lambs were identified by ear tags and their sex recorded. Male lambs were cas-
trated at 1 day old, after the first weighing. Each lamb was weighed and a blood
sample obtained at 24-36 hours, 1-3 weeks, 3-5 weeks and 8-11 weeks of age.
These times will hereafter be referred to as 1.5 days and 2, 4 and 10 weeks
respectively.

For growth rate studies, the lambs were considered to constitute four groups
according to the mean daily liveweight gains achieved. The four groups, A, B, C
and D reflected mean daily weight gains of less than 0.250 kg, 0.250-0.299 kg,
0.300-0.350 kg and more than 0.350 kg respectively. The weight gains were cal-
culated for three separate periods, namely 1.5 days to 2 weeks, 2-4 weeks and
4-10 weeks of age. Thus, the assignment of a lamb to a group could vary from
period to period, depending on its mean daily liveweight gain.

Venous blood samples were collected into 7 ml Vacutainer tubes (Becton-
Dickinson Ltd., Wembley, U.K.), allowed to clot and centrifuged for harvesting of
serum. Samples were stored at -70°C for less than 8 weeks since LDH is known to
be stable for at least 8 weeks at this temperature (Beatty, 1983). Total LDH was
estimated using a commercial kit (LDH-L-SVR, Calbiochem-Behring, La Jolla,
California, U.S.A.), the change in absorbance being measured spectrophotometric-
ally at 30°C.

LDH isoenzymes were separated by polyacrylamide gel electrophoresis on an