NOTA BREVE

ERYTHROCYTE REDUCED GLUTATHIONE IN SAYAGUESA AND AVILEÑA-NEGRA IBERICA CATTLE

GLUTATIÓN ERITROCITARIO REDUCIDO EN LAS RAZAS DE GANADO VACUNO SAYAGUESA Y AVILEÑA-NEGRA IBERICA

Arranz, J.J., Y. Bayón and F. San Primitivo

Departamento de Producción Animal. Universidad de León 24071 León. España.

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Palabras clave adicionales

SUMMARY

The concentration of erythrocyte reduced glutathione (GSH) was studied in Sayaguesa cattle (n=150) and in two populations of Avileña-Negra Ibérica cattle, referred to as A-NI 1 (n=141) and A-NI 2 (n=141).

Variation, but not polymorphism, was found for GSH content in any of the groups examined. Moreover, the frequency distributions did not significantly deviate from normality. Mean values of glutathione levels were 54.61±1.71 mg, 66.66±1.67 mg and 64.41±1.74 mg/100 ml red cells in A-NI 1, A-NI 2 and Sayaguesa cattle, respectively. Significant differences in GSH content were detected between the two populations analysed of Avileña-Negra Ibérica, whereas GSH level in one of those populations (A-NI 2) did not significantly differ from that of Sayaguesa cattle.

INTRODUCTION

Reduced glutathione (GSH) is a tripeptide which has been found to be involved in many metabolic processes, being of special interest its role as an antioxidant in the erythrocyte.

Large inter- and intraspecies

variability has been detected in erythrocyte GSH concentrations in mammals caused both by environmental and genetic factors.

Genetic polymorphism in GSH levels is known to occur in some breeds of sheep, in which different forms of GSH deficiencies have been described with distinct biochemical causes and genetic control (Tucker and Kilgour, 1970, 1972; Board et al., 1974; Tucker et al., 1983; Bayón et al., 1994). The GSH polymorphism has also been reported in a few cases in other mammals as goats (Agar et al., 1974; de la Haba et al., 1991) and cattle (Makaveev, 1979).

Little information is available in cattle concerning GSH concentrations. The aim of the present study was to investigate the distribution of erythrocyte glutathione concentrations in two breeds of Spanish cattle in order to know whether they showed GSH polymorphism.

MATERIALS AND METHODS

A total of 432 cattle were studied belonging to the following Spanish breeds:

- Sayaguesa (n=150) - It is considered as a threatened breed (Avon, 1990) due to the small number of animals, which are located in the province of Zamora.

- Avileña-Negra Ibérica - This breed is made up of a very heterogeneous group of animals distributed along a wide area of central Spain, which

**Figure 1.** Distribution of erythrocyte GSH concentrations in Avileña-Negra Ibérica cattle (A-NI 1 population). (Distribución del GSH eritrocitario en la población A-NI 1 de la raza Avileña-Negra Ibérica).

**Figure 2.** Distribution of erythrocyte GSH concentrations in Avileña-Negra Ibérica cattle (A-NI 2 population). (Distribución del GSH eritrocitario en la población A-NI 2 de la raza Avileña-Negra Ibérica).

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Figure 3. Distribution of erythrocyte GSH concentrations in Sayaguesa cattle. (Distribución del GSH eritrocitario en la raza Sayaguesa).

in some cases show morphological differences. In the present study, two populations geographically and reproductively isolated were studied. Those populations are located in the provinces of Avila (n=141) and Soria (n=141) and will be referred to as A-NI 1 and A-NI 2, respectively.

Heparinized blood samples were obtained by jugular venipuncture and analysed in the laboratory within 8 hr after collection. Levels of reduced glutathione were measured on whole blood following the 5-5'-dithiobis (2-nitrobenzoic acid) (DTNB) method of Beutler et al. (1963). The GSH concentration in the erythrocytes was estimated on the basis of the whole blood contents and haematocrit values.

RESULTS

The distributions of erythrocyte reduced glutathione concentrations obtained in the three groups of animals studied are depicted in figures 1 to 3, measurements on GSH levels being included in table 1.

Distribution of contents was quite broad, individual values ranging from

Table 1. Measurements of erythrocyte GSH in Sayaguesa and Avileña-Negra Ibérica cattle. (Datos de las concentraciones de GSH eritrocitario en las razas de ganado vacuno Sayaguesa y Avileña-Negra Ibérica).

<table>
<thead>
<tr>
<th>Breed</th>
<th>n</th>
<th>Mean</th>
<th>S.E.</th>
<th>Minimum value</th>
<th>Maximum value</th>
<th>Deviation from normal distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-NI 1</td>
<td>141</td>
<td>54.61*</td>
<td>1.71</td>
<td>7.13</td>
<td>118.79</td>
<td>d=0.03</td>
</tr>
<tr>
<td>A-NI 2</td>
<td>141</td>
<td>66.66*</td>
<td>1.67</td>
<td>16.30</td>
<td>105.10</td>
<td>d=0.06</td>
</tr>
<tr>
<td>Sayaguesa</td>
<td>150</td>
<td>64.41*</td>
<td>1.74</td>
<td>21.70</td>
<td>129.30</td>
<td>d=0.08</td>
</tr>
</tbody>
</table>

Values not sharing a common superscript are significantly different (p<0.05).

7.13 mg to 129.30 mg/100 ml red cells.

It was not possible to detect the existence of different populations within each group of animals studied. The Kolmogorov-Smirnov test was used in order to determine whether the distributions obtained showed a significant deviation from normal distribution, the result being that all the groups followed adjustment to normality (see table I). We can thus conclude that neither Sayaguesa, nor Avileña-Negra Ibérica exhibited polymorphism in red cell GSH content.

Mean values obtained for GSH concentrations were 54.61±1.71 mg, 66.66±1.67 mg and 64.41±1.74 mg/100 ml red cells in A-NI 1, A-NI 2 and Sayaguesa cattle, respectively. Significant (p<0.05) differences were detected in mean GSH levels between the two populations examined of Avileña-Negra Ibérica cattle, whereas one of them (A-NI 2) showed GSH contents which did not significantly differ from those found in Sayaguesa cattle.

DISCUSSION

The importance of erythrocyte reduced glutathione content derives from its functions in the metabolism, among which we can point out its role as a protector of cell components from oxidation. It has also been indicated that lactating mammary tissue utilizes the constituent amino acids of glutathione for milk-protein synthesis (Baumrucker et al., 1981).

Although GSH concentration is influenced by environmental factors, such as nutrition, temperature and age, it is known to have an important genetic component (Board and Agar, 1983). These authors indicate that this level of genetic control is the result of the cumulative action of a number of genes at different sites in the metabolism of GSH. Moreover a Mendelian inheritance has been reported in some occasions as determinant of the phenomenon of «GSH deficiency».

Polymorphism of erythrocyte reduced glutathione was firstly reported in sheep (Tucker and Kilgour, 1970). In that species a bimodal distribution in GSH content has been obtained in some breeds, explained through simple Mendelian inheritance, although various biochemical origins and genetic loci seem to be involved in the determination of sheep GSH deficiency.

GSH polymorphism has not been found in other studies. This is the case of some Spanish breeds of sheep (De la Haba et al., 1988) and goats (Vallejo et al., 1989).

In cattle, genetic GSH polymorphism was reported by Makaveev (1979) in Holstein-Friesian, differentiating the low-GSH and high-GSH type, similarly to the sheep model. However, apart from this, little research has been performed on erythrocyte glutathione in that species and available information is very limited.

Our results indicate that the distribution of GSH concentrations in erythrocytes was very wide, both in Avileña-Negra Ibérica and
Sayaguessa cattle (individual values ranging between 7.13 and 129.30 mg/100 ml red cells). Many of those measurements should be indicative of a GSH deficiency if we take into account the limit values considered in sheep between low and high-GSH type (55 mg/100 ml red cells according to Tucker and Kilgour, 1970). However, the distribution of GSH content did not significantly differ from a normal distribution in either of the populations studied. Thus, it was not possible to differentiate groups of animals within each population and we can conclude that genetic GSH polymorphism was not apparent neither in Avileña-Negra Ibérica nor in Sayaguessa cattle.

The differences detected in mean GSH values between the two populations analysed of Avileña-Negra Ibérica cattle were not unexpected if we consider that A-N 1 and A-N 2 populations are located in different provinces and they have been both geographically and reproductively isolated for a long time. Moreover significant differences in biochemical polymorphisms have also been detected between those populations (Arranz et al., 1993). Large differences in GSH distribution within breeds have also been found in sheep. It is the case that GSH polymorphism has been evidenced in some strains of Merino breed and it has not been detected in others (de la Haba et al., 1988).

As regards the possible relationship between erythrocyte glutathione and productivity, the findings have not been very clear. Board and Agar (1983) made a review of the studies on GSH as a potential biochemical marker of milk or meat production in cattle and of meat or wool production in sheep. The conclusion was that the results have been very variable, not always consistent and in some cases conflicting.

The biological meaning of the existence of GSH polymorphism in certain breeds of animals is not clear. The studies on GSH deficiency, most of them in sheep, show that the phenomenon is very complex and caused by different biochemical mechanisms, influenced both by genetic and environmental factors, which in many cases remain unexplained.

REFERENCES

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