



# Trend overtime of total haemoglobin, iron metabolism and trace minerals in veal calves fed high amounts of two different solid feeds

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**ABSTRACT** - Fifty Polish Friesian veal calves were administrated high amounts of two different solid feeds (maize grain and a mix diet containing 10% of straw and 8% of soy) in addition to the traditional milk replacer diet. Compared to the mix diet, maize grain had a lower content of iron, copper and zinc and a minor fibre level. Effects of the two diets on calves' blood haemoglobin, iron, iron metabolism parameters, copper and zinc concentrations were studied. Haemoglobin concentration resulted higher at the end of the fattening for calves fed the mix diet, as expected. Values remained, however, within ranges that allowed acceptable carcass paleness. Haematic iron, unsaturated iron binding capacity (UIBC) and total iron binding capacity (TIBC) levels were not significantly different between the two solid feeds. Lower copper and zinc blood concentrations resulted for calves fed the mix diet were likely due to the feed fibre interfering with the bioavailability of the two minerals, according to what happens for iron.

*Key words:* Veal calf, Solid feeds, Blood parameters.

**Introduction** - Many studies have been carried out to evaluate, for welfare purposes, the effect of the provision of solid feeds to veal calves on their performance, behaviour and health status (Morisse *et al.*, 1999; Gottardo *et al.*, 2000; Cozzi *et al.*, 2002). Nevertheless, few data are available regarding the effect on blood parameters of such solid feeds, even though they represent a crucial point for meat quality and animal welfare considerations. In this context, this research aims to evaluate the effects of the provision of two solid feeds administrated in excess to the minimum recommended by the calves welfare legislation on blood haemoglobin, iron metabolism and two trace minerals (copper and zinc).

**Material and methods** - The trial lasted 184 days and was carried out in a commercial farm. Fifty Polish Friesian calves were divided into two experimental groups receiving dif-

ferent solid diets: maize grain or a mixed diet (mix) composed by maize grain (57%), carobs (17%), wheat straw (10%), roasted whole soybean seeds (8%), glycerol (5%) and minerals (3%). The calves (aged 31±8.1 days; BW 71.8±4.9 kg) were allotted according to their initial body weight in 5 group pens with 5 calves/pen for each experimental treatment. They were fed the same milk replacer diet twice a day, distributed in an individual bucket. Starting from the second week of fattening a growing amount of solid feed was distributed in a common trough after milk distribution. Samples of solid feeds were monthly collected and analysed for assessing chemical composition (AOAC, 1990), iron, zinc and copper content. Blood samples were taken by jugular vein puncture at days 1, 56, 117 and 181 to measure haemoglobin (THB), unsaturated iron binding capacity (UIBC), total iron binding capacity (TIBC), iron (*Fe*), zinc (*Zn*) and copper (*Cu*) concentrations. Data collected were processed using the PROC GLM (SAS, 2001) adopting a linear model which considers the effect of type of solid feed, sampling day and the nested effect of pen within type of solid feed. The nested effect was used as error term.

## Results and conclusions

– Maize grain is a concentrate feed extensively used in veal calves rearing because of its low cost and iron

content. The mix diet had a comparable protein content to maize grain, but structural carbohydrates fraction was higher (NDF: 19.1 vs. 10.6; ADF: 7.7 vs. 1.9), due to the presence of straw. Maize grain had a lower content of iron, copper and zinc compared to the mix diet (Table 1). Plasma concentrations of *Fe*, UIBC and TIBC were similar in both dietary treatments (Table 2). In particular, *Fe* concentrations, starting from 140 µg/dl at the beginning of the fattening and decreasing to 50 µg/dl prior to slaughtering, were similar to those obtained for calves fed only milk replacer as shown by Cozzi *et al.* (2002) (Table 2).

Calves fed the maize grain diet showed, as expected, a significantly lower THB starting from the third blood withdrawal. On the basis of this result calves fed maize grain revealed a slight state of anaemia (7.6g/dl), whereas those fed the mix diet showed a THB value of 8.6 g/dl indicating an improved animal welfare and an acceptable carcass paleness. Despite the high difference in iron content between the two diets and the highest intake of solid feed in the mix diet (157 vs. 147kg DM/head), the final level of THB showed a low difference. This seems to confirm the data described previously in veal calves (Cozzi *et al.*, 2002) and in humans (Reinhold, 1982; Leigh *et al.*, 1983) suggesting that there is not a direct relationship between iron intake and plasma iron concentrations in particular when high fibrous fractions are present in the solid feeds. Moreover, similarly to what reported for iron, roughage constituent of the diet can affect the bioavailability of minerals such as zinc and copper in ruminants (Spears, 2003). Calves fed the mix diet showed a significant lower plasma *Zn* and *Cu* concentrations in comparison to the maize grain diet, despite the higher content of both minerals in the solid feed (Table 2). Moreover zinc bioavailability can be reduced by the presence of soy, as reported by Xu *et al.* (1997). In conclusion, the two

Table 1. Trace minerals content of the solid feeds (mean ±sd).

Diet composition	Measure	Maize grain	Mix diet
Iron content	ppm DM	32.5 ± 9.5	100.0 ± 57.2
Copper content	"	3.6 ± 1.2	7.4 ± 2.4
Zinc content	"	19.4 ± 4.3	52.6 ± 24.4

Table 2. Trend of blood parameters in veal calves fed two type of solid feeds.

Day	THB (g/dl)			Iron ( $\mu\text{g/dl}$ )			UIBC ( $\mu\text{g/dl}$ )		
	Type of solid feed		SE	Type of solid feed		SE	Type of solid feed		SE
	Maize Grain	Mix Diet		Maize Grain	Mix Diet		Maize Grain	Mix Diet	
1	10.9	10.5	0.48	126.4	137.3	15.77	412	394	30.63
56	9.3	9.5	0.35	54.9	54.9	8.13	441	441	22.22
117	8.1 <sup>b</sup>	8.8 <sup>a</sup>	0.21	43.2	50.8	7.70	661	618	26.60
181	7.6 <sup>b</sup>	8.6 <sup>a</sup>	0.27	50.2	55.7	11.05	683	638	26.04
Day	TIBC ( $\mu\text{g/dl}$ )			Zinc ( $\mu\text{mol/l}$ )			Copper ( $\mu\text{mol/l}$ )		
	Type of solid feed		SE	Type of solid feed		SE	Type of solid feed		SE
	Maize Grain	Mix Diet		Maize Grain	Mix Diet		Maize Grain	Mix Diet	
1	538	532	26.05	15.4	16.3	1.48	9.1 <sup>b</sup>	11.2 <sup>a</sup>	0.80
56	509	496	12.85	21.7 <sup>a</sup>	16.2 <sup>b</sup>	1.22	10.2	9.7	0.79
117	705	668	26.25	19.5 <sup>a</sup>	12.6 <sup>b</sup>	1.21	11.6	11.6	0.65
181	733	694	22.12	21.8 <sup>a</sup>	15.7 <sup>b</sup>	0.96	14.3 <sup>a</sup>	11.7 <sup>b</sup>	0.67

Least square means in a row with different superscript letters are significantly different ( $P < 0.05$ ).

different diets determined similar *Fe*, UIBC and TIBC values in all animals but showed a higher THB and a lower blood *Zn* and *Cu* concentrations in calves receiving the mix diet. These results show that fibrous fractions and soy in feedstuffs could affect iron and trace minerals bioavailability.

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