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Calf Note #49 – Red blood cell protein in calf milk replacers

Introduction

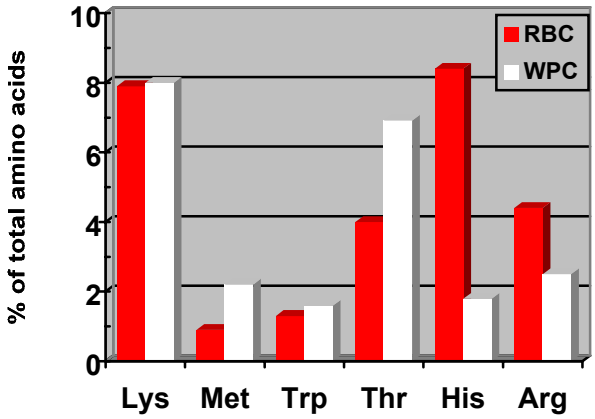
Milk replacers have traditionally contained milk-based ingredients as their major source of protein. In fact, one of the original reasons that milk replacers were developed in the first place was to find alternative uses for whey proteins. However, as more milk proteins are being used by the human food industry, milk proteins are becoming more and more expensive and alternative sources of protein have been formulated into many different kinds of milk replacer. There are many different alternative proteins, including:

- soy flour, modified soy flour
- soy protein concentrate
- soy isolate
- wheat isolate
- potato protein
- fish meal
- animal plasma
- red blood cells

Red blood cell proteins (**RBCP**) have been introduced to the milk replacer industry in the U.S. in the past five years by APC Company, Inc., in Ames, IA. This ingredient has been incorporated into calf milk replacer formulations and fed to calves, primarily in the western U.S. Within the limited market area, the milk replacers containing RBCP have been well accepted by the calf raising industry, primarily because of excellent animal performance at lower cost compared to all-milk formulations.

Red blood cell protein is very high in protein (>85%) and has an excellent amino acid profile (see figure). The RBCP can be derived from bovine or porcine blood and is produced as a co-product of plasma production. Animal plasma is an ingredient in the diets of many farm animals, including pigs (a majority of nursery diets in the U.S. contain animal plasma). In addition to protein, RBCP contains significant ash (about 3 to 5%) and very little fat and no carbohydrate. When mixed with other ingredients in milk replacer, the RBCP produces a chocolate-brown colored powder. The product has a characteristic smell, which is easily masked by the addition of typical flavors added to milk replacers.

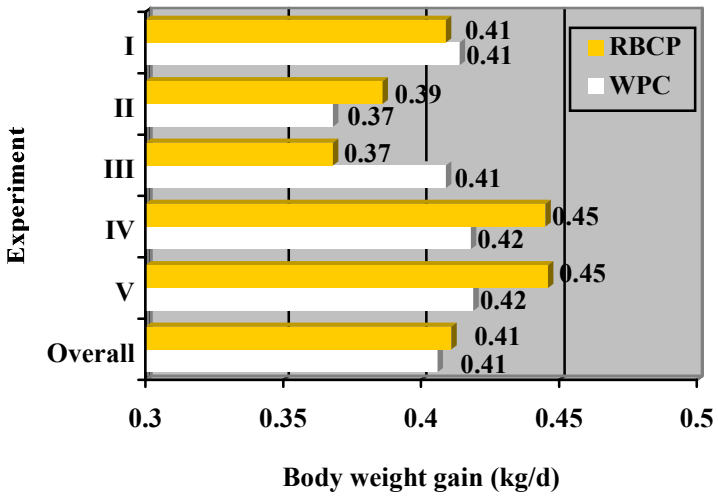
In addition to ash, RBCP contains significant iron, which will increase the amount of iron in the finished milk replacer. Although most commercial formulations are supplemented with iron (typically ferrous sulfate), milk replacers containing RBCP do not contain supplemental inorganic iron. The total iron in the finished milk replacer may be two or three times the NRC requirement for iron (100 ppm). Obviously, the high amount of iron in RBCP precludes its use in veal formulations.



The decision to use RBCP in calf milk replacers is usually made on the basis of cost and performance. There are advantages and disadvantages to using RBCP in calf milk replacer formulas. They include:

Advantages of RBCP in calf milk replacers include:

- Lower cost. Most milk replacers containing RBCP cost less than all-milk replacers of similar nutrient specification. This is because RBCP is a less expensive source of protein than WPC.
- Similar performance to all-milk replacers. Five research trials conducted by APC Company (see figure) showed similar BW gain in calves fed calf milk replacer containing WPC or RBCP. Calves were fed 454 g (1 lb) of milk replacer powder per day for 26-42 days. Calf starter was offered for ad libitum intake.
- Lack of antigenic factors. Unlike soybean protein (particularly soy flour), RBCP contains no antigenic factors that can reduce animal performance. Researchers and feed companies have developed processing methods to reduce the antigenicity of soy-containing milk replacers, but in many instances, some antigenic factors remain. The lack of antigenic factors in RBCP makes this ingredient very competitive in terms of animal performance.



Disadvantages of RBCP in calf milk replacers include:

- Different color of milk replacer. Milk replacers containing RBCP typically have a "chocolate brown" color. For some producers, the difference is difficult to accept at first, since the product does not look "like milk". Calves don't care. Consumption of milk replacers containing RBCP is similar to all-milk replacers. It is important to consider that >75% of the formula used to make the milk replacer is similar to an all-milk replacer.

- Change in fecal color. Feces of calves fed milk replacers containing RBCP will typically be darker in color, due to the presence of iron. Because this iron in unavailable to the animal, it is passed in the feces. This has no nutritional or biological effect on the calf, but does require proper interpretation.
- Different colored residue in utensils. Bottles, buckets and utensils used to feed milk replacer containing RBCP may contain a dark residue after feeding. This residue is typical for all types of milk replacers - however, with all-milk replacers, the residue is white and less noticeable. This often meant that producers feeding all-milk protein replacers did not clean their bottles and utensils sufficiently, as they could not as readily see the residue in the bottles.
- Ileal digestibility of amino acids is slightly lower than skim milk powder or whey protein concentrate, but is similar to other alternative proteins.

Some veterinarians have challenged the use of RBCP in milk replacers, suggesting that the relatively high iron concentration of RBCP would have a negative effect on calf health. Some bacteria, particularly gram negatives, have a high iron requirement, and these researchers contend that increased availability of iron in milk replacer would lead to increased incidence of scours in calves fed RBCP. This is untrue. Research has shown that growth rates of gram negative bacteria (*E. coli* O157:H7, *Salmonella typhimurium*, and enteropathogenic *E. coli*) were similar when these bacteria were grown in a medium containing all-milk milk replacers or milk replacers containing RBCP. In addition, research conducted at several universities and commercial feed companies have shown no difference in rates of diarrhea when calves were fed milk replacers containing WPC or RBCP. Finally, research conducted at Kansas State University found that the bioavailability of the iron in RBCP was only 25% of ferrous sulfate when fed to young pigs. Therefore, it is reasonable to conclude that the increased iron intake does not have an effect on growth of enteric pathogens in young milk-fed calves.

Growth of bacteria when incubated in media containing milk replacers containing red blood cells (RBC-A, RBC-B) or all milk protein (WPC). From Arthington et al., 1998.

Pathogen	RBC-A	RBC-B	WPC
	growth rate (log CFU/hour)		
E. coli O157:H7	0.7	0.6	0.8
Salmonella typhimurium	0.8	0.7	0.8
Enterophathogenic *E. coli*	0.6	0.4	0.6

Conclusion. Red blood cell protein is an acceptable ingredient for calf milk replacers. It will comprise a relatively small amount of a milk replacer formula (5-15%) yet may reduce the overall cost significantly. Remaining ingredients are similar to conventional (white) milk replacers. Producers should objectively evaluate the performance of calves fed calf milk replacers containing RBCP, as well as the economics and improvements in feed efficiency.

Written by Dr. Jim Quigley (10 December 1998; Updated 02 January 2001).

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