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Water and concentrate intake, weight gain and duration of diarrhea in young suckling calves on different diets

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ABSTRACT

Diarrheic calves are fed with milk or milk replacer and oral rehydration solutions (ORS) to ensure energy and electrolyte supply. An easy and time-saving method is the preparation of ORS in milk. As milk-based ORS are hypertonic solutions administration of them may trigger thirst. Therefore, we hypothesized that restrictively fed calves receiving ORS prepared in milk had a higher water intake than restrictively and *ad libitum* fed calves receiving ORS prepared in water during diarrheic episodes.

The daily water intake was measured in 100 individually-housed Holstein Friesian calves from day 2 to 21 of life. One group of the calves was fed with restrictive amounts of milk, the other group got milk *ad libitum* by an automated milk feeder. Nearly all calves spontaneously developed diarrhea within the observation period from day 2 to 21 of life. In cases of diarrhea the restrictively-fed calves received ORS prepared in milk or ORS prepared in water two hours after their milk meal, whereas the *ad libitum*-fed calves only got ORS prepared in water. All calves had *ad libitum* access to water. The daily intake of water, milk, and ORS and weight gain during diarrheic episode were determined. Data were expressed as arithmetic means (± standard deviation) and analyzed by using a one-way ANOVA or repeated-measures ANOVA.

From day 2 to 21 of life calves fed with restrictive amounts of milk had higher water intakes related to the total dry matter intake (DMI) with 1.6 L/kg of total DMI than *ad libitum*-fed calves (0.9 L/kg of total DMI) per day. In cases of diarrhea water intake increased in all feeding groups. The calves receiving milk-based ORS had the highest water intake with 1.7 L/d during the period of diarrhea compared to the calves received ORS prepared in water. Moreover, the calves fed ORS in milk showed with 4.6 L/d the highest daily ORS intake. There were no differences in the duration of diarrhea or the daily weight gain during period of diarrhea between the feeding regimens. Therefore, it can be concluded that all feeding regimens were suitable in the treatment of calf diarrhea. The simplest method to treat calves suffering from diarrhea is the preparation of ORS in milk, but then *ad libitum* availability of water is absolutely necessary. Moreover, calves drink considerable amounts of water within the first 3 weeks of life and therefore should be provided with water for animal welfare reasons.

1. Introduction

Few studies deal with the water intake of calves (Jenny et al., 1978; Kertz et al., 1984; Hepola et al., 2008). According to the German enactment of animal welfare

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and farming of animals that is called "Tierschutz-Nutztierhaltungsverordnung" (TierschNutztV, 2006) calves over 2 weeks of age have to be allowed *ad libitum* access to water. Prior to this age they must supply their daily need for fluid through the intake of milk or milk replacer (**MR**). Considering the feeding practice of calves there are differences in the water intake between *ad libitum*-fed and restrictively-fed calves. Calves fed MR *ad libitum* drank only 0.45 kg water per day until weaning at the age of 5 weeks (Richard et al., 1988). Whereas animals fed restrictive volumes of MR had a daily water intake of more than 1.0 kg within the first 3 weeks of life (Kertz et al., 1984).

Calf diarrhea especially occurs in the first weeks of life (Azizzadeh et al., 2012) and is associated with fecal losses of water and electrolytes that leads to an isotonic or hypotonic dehydration in diarrheic calves. Hyponatremia is the most common abnormality in blood chemistry in these calves (Dalton et al., 1965). The treatment of calf diarrhea is based on the administration of oral rehydration solutions **(ORS)** for diarrheic calves with a sufficient suckle reflex. In addition to ORS treatment, they should receive their milk meal which is necessary to maintain energy supply (Heath et al., 1989). Preparing ORS in milk or MR is an easy way for farmers to provide diarrheic calves with electrolytes without adverse effects (Bachmann et al., 2009; Goodell et al., 2012). Such milk–ORS-mixtures are hypertonic, and administering them should cause thirst. Therefore, calves receiving milk–ORS have to have *ad libitum* access to water to adjust their hydration status (Bachmann et al., 2012). In a previous study the daily water intake increased 25 to 50% when calves developed diarrhea (Jenny et al., 1978). A similar result was noted by Kertz et al. (1984). In this study calves with *ad libitum* access to water gained more body weight and ingested more calf starter. Currently no study exists which considers the influence of feeding hypertonic ORS on the water intake of diarrheic calves.

The objectives of the present study were to examine the influences of different milk feeding regimens (*ad libitum* and restrictive) on the water, concentrate and milk intake of calves up to 3 weeks of age. Moreover, the influence of 3 different treatment/feeding regimens while diarrheic disease of the calves up to 3 weeks of age on the water, concentrate, milk and ORS intake as well as daily weight gain and duration of diarrhea were determined. The 3 treatment/ feeding regimens during calf diarrhea were *ad libitum* milk feeding plus ORS prepared in water (**milk a.l.+water–ORS**), restrictive milk feeding plus ORS prepared in water (**water–ORS**) and restrictive milk feeding with ORS prepared in the milk (**milk–ORS**).

2. Materials and methods

Experiments were approved by federal authorities for animal research (Landesdirektion Leipzig, Germany) and conducted in accordance with the principles of the German Animal Welfare Act.

2.1. Animals

Water, milk and concentrate intake was measured in 100 calves (54 male and 46 female) from day 2 to 21 of life, born at Köllitsch, Germany, (the farm for teaching and research of the Department of Animal Production of the Saxon State Office for Environment, Agriculture and Geology) from April through September 2012. 92 calves were of Holstein-Friesian breed and 8 were crossbreeding of Holstein-Friesian × Belgian Blue-White. Diarrhea occurred in 98 of these calves. Calves were removed from the study when diseases other than diarrhea occurred such as omphalitis, pneumonia and arthritis with disturbed general condition. This accounted for only 2 calves. The diarrheic period of each calf was determined by its fecal consistency whereas a soupy or watery fecal consistency was classified as having diarrhea. The period of diarrhea was finished when the feces had a pulpy or pasty consistency again. Within the period of diarrhea, data for ORS intake, weight gain and duration of diarrhea were gathered for 81 of the 98 diarrheic calves. These 81 datasets were used for the analysis of diarrheic calves during the period of diarrhea. The calves had *ad libitum* access to water and were provided with hay and concentrate feed.

2.2. Experimental design

Within 30 min after birth each calf was separated from its dam, weighted, moved to an individual calf box with straw bedding where it was randomly assigned to the restrictive milk feeding regimen or the *ad libitum* milk feeding regimen.

The restrictive milk feeding group received 2 L of milk 3 times a day (0700, 1600, 2200 h) via nipple bucket and the other group received milk *ad libitum* at a nipple-feeding station by an automated milk-feeder. Independent of the feeding group, all calves were fed at least 2 L of colostrum from a bottle within 2 h of birth and 2 L at the next usual feeding time.

Experiments started the day after birth. Each morning each calf received a bucket with 5 L of fresh water in its box which was weighted before and again after 24 h. To calculate the evaporation of water from the bucket an additional one was placed in the middle of the area where the newborn calves were housed and also weighted every 24 h. The daily water intake of a calf was calculated by the difference in weight of the bucket of each calf minus evaporation. Each calf also received a bowl with concentrate that was composed in equal parts of a pelleted concentrate (88% dry matter content, 20% crude protein; Kälbersegen 50 16-F, Basu Mineralfutter GmbH, Germany) and crushed barley (proportion of 1:1). The amount of concentrate intake was also determined daily.

Every morning the rectal temperature and the fecal consistency (scored from 1 to 4 where 1=pasty; 2=pulpy; 3=soupy; 4=watery; Groutides and Michell, 1990) of each calf was recorded. Calves with fecal consistency 3 or 4 were classified as having diarrhea. The animals were weighted and a fecal sample was collected and analyzed microscopically for *Cryptosporidium* oocysts according to Heine (1982). Additionally a quick test (Fassisi® BioDa,