Interactions of Nutritional Management and Reproduction - Case Reports

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Deficiencies of most nutrients have been associated with reproductive failure in the cow yet many of these associations have not been proven.[1] Even research-proven interactions may be difficult to prove in client herds. In addition, nutrient intake can also alter response to infectious agents and response to normal physiologic processes that alter reproduction such as suckling and lactation The objective of this manuscript is to describe techniques to diagnose nutrition-associated infertility in cattle. This diagnosis is similar to other diagnoses with the 1) recognition of infertility through history and evaluation of the cows / records; 2) determination of inadequate or excessive nutrient intake with supportive testing of the animals or feed; and 3) confirmation of the diagnosis after intervention.[1] The author recommends the referenced text by McClure as a concise, easy to read manuscript on this subject.

Nutrition-Associated Infertility

Gross malnutrition is easily diagnosed with its associated reproductive failure. The practitioner more often is presented with infertility, and malnutrition is not visibly evident. McClure describes both nutritional and metabolic infertility.[1] Nutritional infertility is caused by malnutrition usually associated with adverse environmental and climatic conditions. Reproduction fails at a point prior to the expression of loss of condition, emaciation, and death. Nutritional infertility would most commonly be observed in beef cattle and dairy replacement heifers. An example would be decreased pregnancy rates in a beef herd whose cows calved at condition scores of less than 4 out of 9 or lack of estrus in 15 month old dairy heifers that weigh 550 lbs. In each case, malnutrition is visibly evident as poor condition scores or as poor growth rates or weight per day of age. Metabolic infertility is associated with an acute nutrient imbalance and thus the cattle show few signs of malnutrition. An example would be lack of estrus in a dairy cow that produces 120 lbs. of milk or poor pregnancy rates in cows fed excessive rumen-degradable protein.

Evaluation of the cows

The diagnosis of nutritional and metabolic infertility may be made in the individual cow, however, herd diagnosis and treatment would be the more common scenario for most practitioners. The expression and rates of occurrence of several physiologic events such as estrus (puberty in virgins), conception / pregnancy, embryonic death, and perinatal mortality can be used to evaluate the role of nutrition in the context of other factors that alter reproduction. Remember the temporal pattern to these events as estrus must proceed pregnancy which proceeds embryonic death, etc. McClure recommends determination of:[1]

- Parturition to first estrus interval and proportion of herd in heat by day 60 post partum
- Parturition to first service interval and proportion of herd bred by day 83 post partum
- First service pregnancy rate
- Parturition to pregnancy interval
- Pregnancy rate over the entire breeding season
- Abortion rate
- Perinatal mortality rate
- Cycle-length distribution

These factors should be stratified or blocked to identify management or risk factors that alter reproduction or to identify cohorts of cows that are affected. Examples are: date of mating, mating method, identity of the bull, age(lactation), presence of suckling calves, pasture groups etc.

Condition Scoring

Condition scores are a visual and sometimes tactile appraisal of primarily fat content of an animal's body. Dairy cattle are commonly evaluated on a 1-5 point scale while beef cattle are evaluated on a 1-9 scale with 1 being thin and 5 or 9 respectively being fat. The present condition score of the cow and the change in condition score over time have been related to reproductive performance. In general, cows should calve in a moderate condition score (5-7 beef cattle, 3-4 in dairy cattle) to promote optimal post-partum fertility. The dairy cow should lose a maximum of 1 condition score from calving to peak lactation, where the beef cow should maintain condition from calving to breeding. The author suggests evaluation of condition scores at calving, breeding, and mid to late gestation to evaluate nutrition / reproduction interactions.

Animal sampling

A metabolic profile would be a useful tool to evaluate the nutritional status of an animal or herd. The perfect test(s), however, do not exist. Animal sampling, therefore, is directed to choosing a group that represents the population at risk, sample enough of them, determine the tests to run, and finally characterize the results. Many dairy herds offer a unique sampling opportunity in that several cohort groups are usually available at any given time, e.g. dry cows, early lactation cows, pregnant cows, etc. Results can then be compared between groups to support the hypotheses. Beef cattle tend to be seasonal calvers and thus a group of "control" cows may not exist. Comparison of the problem group to normal control values from a lab may be less rewarding. An evaluation of various nutrients is given in Table 1. Normal ranges for these elements are for deficiencies which may or may not reflect concentrations for optimal reproduction.

Table 1. Association of sample results and nutrient intake.

Nutrient	Sample	Comments
Energy Balance	Urine, milk, blood ketones	Positive ketones suggests negative energy balance
Protein	albumin serum urea nitrogen	low indicates protein deficiency of weeks/months low indicates protein deficient diet, high indicates excess of soluble or degradable protein in diet
Phosphorus	blood	low indicates inadequate intake, P on ICP is twice as high
Selenium	blood serum	blood reflect Se in RBS, changes over weeks to months serum reflects changes over days to weeks
Copper	serum	low can indicate deficiency, serum Cu increases with stress
Zinc	serum	needs to be collected in special trace element tube, low indicates deficiency, however, serum Zn decreases with stress
Vitamin E	serum	decreases in periparturient period

Determination of Nutrient Intake

Inadequate feed intake

Decreased feed intake can be determined by loss of body condition, poor growth rates, or decreased intake relative to NRC requirements for beef or dairy cattle.

Feed sampling

Many, if not most, times the suspect feed / ration is not present during the time of investigation due to delay between insult and diagnosis because pregnancy exams are performed 40-250 days after breeding. Thus history of feeding programs is crucial. Present feeds can be sampled and submitted for analysis to a certified forage testing lab. At least 10% of bales or 10 hay bales should be cored. Ten to 20 grab samples from the face of silage should be combined and subsampled for analysis.

Feed analysis

A simple analysis usually contains dry matter, protein, fiber, and the macrominerals Ca, P, K, and Mg. NIR analysis of forages is fast but the mineral content may be derived from protein and fiber concentrations. Thus ask for wet chemistry analysis if you desire accurate macromineral concentrations. Additional protein analyses include soluble protein, degradable and undegradable protein. Non-structural carbohydrates may be estimated. Complete mineral analysis includes Fe, Zn, Cu, and Mo. Sulfur, Cl and Se are not commonly analyzed but can be requested at some labs. Vitamin content of feed is not commonly analyzed. Some labs like the Northeast DHI lab can provide reference ranges for the samples submitted to their labs.

Many by-product and commodity feeds are used economically to support milk production. Most mineral supplementation programs are based on traditional feeds. Consider complete evaluation of by-product or commodity feeds if faced with infertility.

Feed storage and delivery

The feed may be harvested at a desired nutrient content but can lose nutrients with improper storage or feeding methods. Heat and improper moisture can destroy nutrients or alter essential nutrients. Fat soluble vitamins are susceptible to temperatures associated with hot summer days and thus stored feed can lose vitamin content over weeks to months. Fermented feeds are also prone to losses. Silages and haylages that are too dry may become too hot and bind protein to fiber, may not pack well and thus oxidize rather than ferment, and may support mold growth. Silages and haylages that are too wet may lose water-soluble nutrients in the runoff below the silo. Hays that are too wet will overheat and mold. Round bales that are stored outside may lose 20-40% of their dry matter, especially if they are stored on wet ground.

Adequate bunk space must be provided for the group being fed. This may range from 8-12 inches for feedlot bulls to 2-3 feet for cows limit fed a supplement. Groups that contain cows of varied sizes and ages may need more space than estimated due to social dominance between cows. Mechanization of feeding systems also increases the chance for error. Inadequate or unbalanced feed scales may still produce a balanced ration, just the wrong amount. Watching the actual feeding process is often boring and unrewarding but occasionally reveals feeding errors.

Confirmation of Diagnosis

Proving your hypothesis may be the most difficult part of the process because of the need to apply the "treatment" to all cows in the group rather than treatment and controls, because multiple therapies are used such as a change in the nutrition and vaccination program, and finally because of the time needed to show results.

Case Scenarios

Poor pregnancy rates in yearling heifers
Determine: How many of the heifers were in heat prior to breeding season?
Comments: Puberty in heifers is controlled by genetic makeup and subsequent growth. A target weight of 65% of mature weight is used as a goal. Pregnancy rates on the first estrus are poor thus heifers should cycle at least once prior to anticipated breeding.

Poor pregnancy rates at fall pregnancy check yet the cows are in good condition
Determine: What was the body condition of the cows prior to calving?
Comments: Condition score at calving ≤ 4 out of 9 results in decreased pregnancy rates as compared to cows ≥ 5. Post-calving nutrition is also important and increased intake 2-3 weeks prior to breeding may help some but will not overcome poor condition at calving. A classic scenario is the drought last summer, the cows went into the winter thin, calved thin, and thus did not cycle during the restricted breeding season. Adequate grass this summer results in increased body condition. Thus a cow's condition at weaning in 1995 can alter pregnancy rates at weaning in 1996.

Decreased pregnancy rates in spite of adequate body condition and estrus expression
Determine: Protein content of ration or serum/milk urea of case and control group.
Comments: Excess protein intake, especially degradable and soluble protein, has been associated with possible embryonic mortality. Cows will cycle normally and be bred but appear not to become pregnant. This author finds the concept very good but the diagnosis is hard. Serum and milk urea contents vary during the day especially in relation to feed intake, thus is your measurement a peak or trough relative to a cutoff value. Likewise an elevated serum urea may indicate a lack of soluble carbohydrates in the ration.

References

1. McClure TJ, Nutritional and Metabolic Infertility in the Cow. Wallingford, CAB International 1994.

Abstract

Nephrotoxicity of *Narthecium ossifragum* in cattle in Norway

A. Flåøyen, M. Binde, B. Bratberg, B. Djønne, M. Fjølstad, H. Grønstøl, H. Hassan, P. G. Mantle, T. Landeverk, J. Schönheit, M. H. Tønnesen
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During the summer of 1992 renal failure was diagnosed in 232 grazing cattle in 85 herds on the west coast of Norway. The salient clinical signs were depression, anorexia and melaena or fresh blood in the faeces; diarrhoea was also commonly observed. The serum concentrations of creatinine, urea, magnesium and phosphorus, and the activities of glutamate dehydrogenase, aspartate aminotransferase and creatine kinase were above normal and the serum calcium concentration was below normal. Post mortem examinations consistently revealed renal tubular necrosis. In some cases there was liver necrosis and also erosions at the base of the tongue, in the oesophagus and in the jejunum and colon. The toxicity was probably caused by the plant *Narthecium ossifragum* (bog asphodel).