# UMR Herbivores

## Team Feed, Digestion, Microbes Metabolism, and Nutrition (Dinamic)

# Towards a multicriteria evaluation of ruminant diets: Defining a set of criteria and indicators

Modern ruminant production systems have to meet the sustainability challenge. Thus, the ruminant diet evaluation systems need to move on to consider new aspects other than traditional feed value, as wastes, animal health and products quality. Although the ruminant diet evaluation concept has already started to evolve, none of these systems proposes an exhaustive and consistent set of criteria for assessing impacts on animal health, wastes or product quality. From literature search and expert's consultations, we proposed an organized set of criteria to evaluate the different impacts of ruminant diets on animal production, animal health, wastes and on the quality of animal products. We obtained a list of 23 criteria. The indicators at feedstuffs scale that need to be collected to appraise the criteria were also identified. These criteria and indicators are currently used to compare feedstuffs and diets for ruminants. This works represents a first step toward a diet formulation tool that optimise diets to multi-impact objectives.

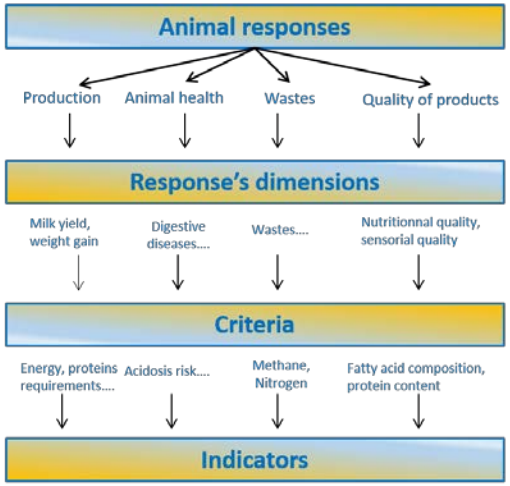
For decades, diets were formulated to meet ruminant requirements at a level that maximized production objectives. Today, ruminant production systems are facing the sustainability challenge, i.e. being productive while reducing environmental impacts and responding to societal concerns about animal welfare and product quality. Thus the objective of diet formulation has changed, and can now be defined as the feeding of a diet balanced in all nutrients and free from harmful compounds, so as to meet production objectives and generate, using ecological practices, animal products that are safe for humans. Most of the feed evaluation systems has already begun to evolve, several systems (INRA, 2018) proposing multiple animal responses to the diets regarding wastes and animal health. However, none of these systems proposes an exhaustive and consistent set of criteria for assessing all responses on animal health, wastes or product quality. There is thus a need to continue to evolve the feed evaluation system toward a diet evaluation tool that allows optimisation of diets taking into account full responses. This aim requires a multicriteria evaluation process in order to consider simultaneously all responses and to propose an aggregated result.

### A participatory approach

Using the building concepts of multicriteria evaluation (Roy, 2006), we defined the conceptual framework to develop a multicriteria evaluation of ruminant diets. Then, from expert's consultation, we defined and organized a set of the criteria to evaluate the different responses of ruminant diets on animal production, animal health, wastes and on the quality of animal products. The experts were from research, vet, technical institute and animal production company. The criteria concerned the following four categories of responses: animal production, animal health, animal wastes and the quality of animal products generated.

### Identified criteria and their indicators

Twenty-three criteria ranked in the four categories of responses were obtained. For "animal production", three criteria were identified (coverage of energy, proteins and minerals requirements). For "animal health", criteria assessing toxicity, digestive diseases, optimal supply in antioxidants and effect on reproductive reproduction were proposed. For "wastes", criteria are methane emissions, nitrogen and minerals wastes. Defining criteria of "product quality" was more complex, as they depend on animal and the purpose of the product. Also, origin of quality is complex and multifactorial. Thus, we focused on milk and meat quality excluding derived products and on criteria on which feeding has a marked and proven effect. Then, we identified for each criterion the potential indicators that needed to be collected to check the conformity of the diet with the criterion. Indicators were measured, estimated or declared variables describing feedstuffs, diet or targeted animal. For example, chemical composition or digestibility of feeds are indicators: crude protein content and organic matter digestibility inform on protein and energy values; tannins are indicators of anti-parasitic properties; carotenoids and polyphenols are indicators of products quality and animal health…




### Utilisation of the set of criteria

This set of criteria can be used today to assess and compare the multicriteria interest of different feeds or diets for ruminants. For example, we used it to study the interest of different new fodder plant species on feed value, animal health, wastes and products quality. For that, we measured different known indicators of the criteria (chemical composition for example) and some in vitro parameters (in vitro fermentation parameters, bloat potential…). We thus showed that the energy and protein values of these new plant species were as good as those of alfalfa. The vitamins composition (carotenoids, vitamin E) of these species were interesting for animal health and product quality. The study demonstrated also a positive effect of sainfoin and buckwheat on wastes: methane and ammonia productions were significantly lower for sainfoin and buckwheat compared to alfalfa. Overall, these new plant species were classified according to their interest other than feed value.

Publications
Cantal Maxin, G., Nozière, P., Sauvant, D., Baumont, R. 2018. Appliquer les méthodes d'évaluation multicritère aux rations des ruminants : identification des critères à évaluer et des indicateurs à mesurer sur les aliments. *INRA Productions Animales*, 31, 255-268, DOI 10.20870/productions-animales.2018.31.2.2328.
Maxin, G. Graulet B., Le Morvan A., Picard F., Portelli J., Andueza D. 2020. Cover crops as alternative forages for ruminants: nutritive characteristics, in vitro digestibility, methane and ammonia production. *Animal Production Science,* 60, 823-832, https://doi.org/10.1071/AN19091.
Maxin G., Le Morvan A., Laverroux S., Graulet B. 2017. Nutritive composition, carotenoid, tocopherol and tannin contents of cover crops used as forage plants for ruminants. 12th FAO Mountain Cheese meeting, Padoue, Italy, 20-22/06/2017.
Maxin G., Nozière P., Baumont R. 2018. Identification of a first set of criteria for a multicriteria evaluation of diets for ruminants. 10th International Symposium on the Nutrition of Herbivores. Clermont-Ferrand, France.

Reference:
Roy B., 1996. Multicriteria methodology for decising aiding. Kluwer Academic, Dordrecht, The Netherlands.

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Legend: Four categories of animal responses were considered for the multicriteria evaluation of ruminant diets: animal production, animal health, wastes and products quality. Within each category, different dimensions were defined, then detailed in criteria assessing using indicators measured or estimated at feedstuffs scale.