

Optim'AI, an economic optimization tool of ruminant rations, for a better use of by-products



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The economic interest of agro-industrial by-products is a major advantage for ruminant feeding systems but...

Forage-concentrate substitution
 Loss of energy during digestion
 Nitrogen and energy availability for microbes

= non additive parameters
 → difficult to be taken into account in a linear programming approach
 ⇒ Economic optimization in ruminant feeding strategies is rare

Optim'AI

Dairy cows

A new original tool
 to calculate the less expensive diet
 in ruminant production

Optim'AI

Beef production

1. A fast and simple tool

Animal characteristics

Definition of animal performances
 (→ intake, energy, protein, calcium and phosphorus requirements)
 Possibility to modulate the animal needs

Feed characteristics

Energy, protein and mineral contents (INRA data base)
 Possibility to fill in the data base with user's own data

Constraint set

Constraints can be used on:

- Incorporation limits for individual feeds
- Incorporation limits for feed groups (by-products for example)
- Concentration limits (% crude protein, % dry matter, % fiber, etc.)

2. A high scientific model

INRA 2010 based calculation model

All recent concepts taken into account:
 - Forage-concentrate substitution
 - Digestive interactions
 - Protein/energy availability for microbes
 ⇒ Iterative calculation process

Economic optimization of the diet

Least-cost approach
 using linear programming

- Primal analysis
 feeds quantities, prices and diet characteristics
- Dual analysis
 invariance stages, feed price equivalence

3. A synthetic view of results

Description of the optimized diet

| Ration | Prix €/tMS | Prix €/t brut | Quantité kg MS/j | Quantité kg brut/j | Contrainte nature | Plage d'invariance Prix min €/tMS | Prix max €/tMS |
|---|------------|---------------|------------------|--------------------|-------------------|-----------------------------------|----------------|
| Ensil. Pr. Perm. 1 ^{er} déb. ép. | 104,0 | 35,2 | 15,797 | 47,155 | | 0,0 | 127,2 |
| Dr. Brasserie Fraîche | 220,0 | 55,0 | 1,729 | 6,914 | | 138,4 | 256,5 |
| Foin Pr. Perm. 1 ^{er} ép. | 120,0 | 102,0 | 1,700 | 2,000 | | 96,8 | --- |
| Blé | 180,0 | 156,2 | 2,828 | 3,259 | | 116,9 | 246,7 |
| T. Colza | 300,0 | 266,1 | 0,427 | 0,481 | | 273,8 | 796,9 |
| Carbonate de Ca | 50,0 | 47,5 | 0,516 | 0,543 | | 0,0 | 73,2 |

Dual analysis of the least-cost ration

| Valeurs nutritionnelles | Apports /j | Besoins min | Besoins max | Contrainte saturée | Concentration |
|-------------------------|------------|-------------|-------------|--------------------|-----------------|
| UEL (g) | 20,8 | 18,0 | 20,8 | Max | 0,90 UEL/kg MS |
| UFL (g) | 19,2 | 19,2 | 23,0 | Min | 0,83 UFL/kg MS |
| PDIN (g) | 2161 | 1927 | 2505 | | 94 g/kg MS |
| PDIE (g) | 1927 | 1927 | 2505 | Min | 84 g/kg MS |
| P abs (g) | 53,2 | 47,4 | 96,4 | | 2,3 g/kg MS |
| Ca abs (g) | 117,2 | 58,0 | 117,2 | Max | 5,1 g/kg MS |
| MS | | | | | 381,0 g/kg brut |
| MAT | | | | | 146,2 g/kg MS |
| CB | | | | | 238,7 g/kg MS |
| NDF | | | | | 490,3 g/kg MS |
| ADF | | | | | 266,3 g/kg MS |
| ADL | | | | | 7,8 g/kg MS |
| MGR | | | | | 26,1 g/kg MS |
| Amidon | | | | | 91,5 g/kg MS |

Detailed characteristics of the diet

| Groupes | Quantité kg MS/j | Quantité kg brut/j | Contrainte saturée | Concentration |
|------------|------------------|--------------------|--------------------|-----------------|
| Foins | 1,700 | 2,000 | Min | 7,4 % MS tot. |
| Céréales 1 | 2,828 | 3,259 | Max | 75,1 % MS conc. |
| Pulpes | 0,000 | 0,000 | Min | 0,0 % MS tot. |

Synthetic information

| Récapitulatif de la ration | | Coût de la ration pour 1000 L de lait | |
|---------------------------------------|------------|---------------------------------------|---------|
| Coût par vache laitière | 2,91 €/j | Coût | 96,85 € |
| MS totale | 23,0 kg/j | Production permise | |
| MS fourrage | 19,2 kg/j | Par les UF | 30 kg/j |
| MS concentré | 3,8 kg/j | Par les PDI | 30 kg/j |
| % de concentré | 16,4 % | | |
| Taux de substitution global | 0,40 | | |
| Perte énergie interactions digestives | 0,62 UFL/j | | |
| Coefficient interactions digestives | 0,97 | | |
| Rapport microbien (PDIN-PDIE)/UFL | 12 g PDI | | |

Opportunity costs of non-used feeds

| Aliments non retenus | Prix actuel €/t MS | Prix actuel €/t brut | Prix d'intérêt €/t MS | Prix d'intérêt €/t brut |
|--------------------------------------|--------------------|----------------------|-----------------------|-------------------------|
| Ensil. Pr. Perm. 1 ^{er} ép. | 110,0 | 36,9 | 82,8 | 27,7 |
| P. Betterave suppr. ensil. | 999,9 | 2199,8 | 134,5 | 29,6 |
| Ensil. Maïs 35%MS | 999,9 | 3499,7 | 112,9 | 39,5 |
| Phosphate mono-bicalc. | 450,0 | 405,0 | 58,3 | 52,4 |
| Urée | 450,0 | 441,0 | 52,8 | 51,5 |

To go further ahead in the analysis

Optimiser aux bornes
 Choisir un aliment et son prix en €/t MS
 Dr. Brasserie Fraîche : 257 €/t MS (Max)

Optimiser avec le prix d'intérêt choisi | Optimiser avec les prix initiaux

Conclusion

Optim'AI is a user-friendly and powerful tool available for farm advisors, gathering scientific concepts of INRA feeding systems and economic approaches in the field, for a better evaluation of the economic interest of feeds, including by-products, in ruminant diets.