level throughout the year of between 1700 and 2100 kg DM.ha^{-1}. 300 kg DM.bale^{-1} and a feeding value of hay relative to pasture of 0.85% were assumed. Losses of 10% and 10 MJ ME.kg DM^{-1} was assumed when this was fed back into the system (Hay is available as feed in the next month).

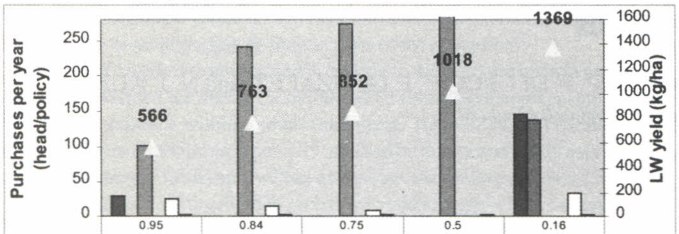
RESULTS AND DISCUSSION

From the pasture distribution sampling, the highest variable months were over the November to March period (results not shown). Pasture yield per annum varied

Table 1: Summary of assumptions in the five bull beef policies

Value/Policy (+)	1	2	3	4	5
Initial LW (kg/head)	100	100	100	380	365
Month of purchase	Nov.	Nov.	Nov.	Aug.	Mar.
LW of wintered animals					
1Ry bull (kg/head)	349	285	188	-	468
2Rybull (kg/head)	-	-	473	-	-
Live-Weight at sale (kg/head)	600	550	650	600	650
Month of sale (*)	Dec.	Feb.	Jan.	Feb.	Dec.
Produced LW (kg/unit/year)	495.4	446.0	544.5	217.8	282.1
Meat/unit/year (kg Cwt)	252.7	227.5	227.7	111.1	143.9
INTAKE					
Winter (DM kg/unit)	842	601	1221	561	884
Spring (DM kg/unit)	1428	1186	1862	1046	861
Summer (DM kg/unit)	672	1249	1123	389	266
Autumn (DM kg/unit)	711	525	1031	0	755
Whole year (DM kg/unit)	3652	3560	5237	1995	2766

(+) Including top, middle and bottom animals
(*) Represents the sale of middle animals (60 % of sales)



	0.95	0.84	0.75	0.5	0.16
T1	30	0	0	0	145
T2	0	0	0	0	139
T3	101	241	274	333	0
T4	0	0	0	0	0
T5	27	14	8	0	35
Hay (bales/ha)	1.4	1.3	1.5	1.9	1.1
Kg LW/ha	566	763	852	1018	1369

Probability of reaching target (%)

Figure 1: Different mixes of policies (purchases per annum) and bales.ha^{-1}.year^{-1} to optimise LW. ha^{-1} year^{-1} at distinct level of certainty of herbage yield.

between 7.4 and 14.6 ton.year^{-1}.ha^{-1}. Highest CC of each month yield-variation to per annum pasture output were for 0.47, 0.43, 0.41 and 0.37 for December, March January and October respectively. The lowest CC were –0.8, 0.10 and 0.12 for June, August and September.

Figure 1 shows the different mixes of policies to optimise kg LW. ha^{-1}.year^{-1} at distinct levels of certainty of herbage output. When a low level of risk is selected (up to 0.5), the model included T3 as the main option. However, in order to maximize per ha yield at a higher level of risk (0.16), policies which are more demanding during late spring-summer (policies 1 and 2) were mainly selected. High risk conditions systematically decreased the level of pasture reserves and were associated with a higher utilisation of grass by increasing stocking rate.

By accepting a higher level of risk, output per ha increased, shown by the following linear equation:

$$\text{kg LW. ha}^{-1}: 1520.8\ (53.5) - x\ 948.8\ (76.5) \quad R^2: 0.98 \quad P<0.001 \qquad \text{(Equation 3)}$$

x: level of certainty

CHCLP represented an acceptable tool to analyse the trade-off between alternative bull policies while considering seasonal distribution of pasture and in future pasture quality. Although it would be desirable to take into account the covariance´s between the pasture yield in different months within a model with joint chance constraints, this was discarded because to solve such problems special purpose solvers would be needed (Kall and Mayer 1996), decreasing the friendly nature of this simple model.

This CHCLP model provides an acceptable tool both for teaching purposes and exploring productive alternatives. Although the economic optimisation was beyond the objectives of this exercise, when this was attempted (not shown), the selected mix of classes was completely different to those presented in Figure 1. Thus, economic and financial information should be added before suggesting a particular policy mix.

Risk in quantity-quality of pasture yield has shaped farming practices, and farmers have developed different strategies to cope with this variation, such as flexibility of slaughter date, changing stocking rate, feeding supplements etc. (Pleasants et.al. 1995). This model can be used to test the productive feasibility of different bull beef policy alternatives, and by including their economic and financial information, other strategies to improve the flexibility of the system could be evaluated.

REFERENCES

AFRC. (1993). Energy and protein requirements of ruminants. Published by the AFRC technical Committe on response to nutrients. 101 p.

Dake CKG. (1994). Variable animal performance and farm diversification. Proceeding of the New Zealand Society of Animal Production **54**:1-9.

Dent JB, Harrison SR, Woodford KB. (1986). Farm planning with linear programming: concept&practice. Butterworths Pty limited.

Kall P, Mayer J. (1996). SLP-IOR: An interactive model management system for stochastic linear programs. Mathemathical Programming **75**:221-40.

Pleasants AB, McCall DG, Sheath GW. (1995). The management of pastoral grazing system under biological and environmental variation. Agricultural Systems **48**:179-92.

ID # 32-07

Sequential injection analysis: a powerful tool for routine soil and plant laboratories

A.R.A. NOGUEIRA[1], F.V. SILVA[1,2], M.Y. KAMOGAWA[1,2], G.B. SOUZA[1] and L.F.M. FERRAZ[3]

[1]*Embrapa Pecuária Sudeste, PO Box 339, 13560-970, São Carlos SP, Brasil*

[2]*Departamento de Química, UFSCar, São Carlos, SP, Brasil*

[3]*Embrapa Instrumentação Agropecuária, São Carlos, SP, Brasil*

ABSTRACT

Sequential injection analysis (SIA) present attractive characteristics for analyses in large scale. In SIA the analytical determination can be performed automatically reducing the number of steps usually involved in a chemical analysis. In order to demonstrate the advantages found in the implementation of a SIA procedure in a laboratory dedicated to routine analyze, the determination of volatile nitrogen in silage and soil samples has been performed. The nitrogen content was determined after NH_3 on-line separation in alkaline conditions by using a gaseous diffusion or a pervaporation unit for liquid-liquid separation. An ammonium tubular selective electrode detector was used for determinations.

KEYWORDS: Large scale analyses, automation of analytical procedures

INTRODUCTION

Quality control and characterization of agronomic materials are assessed determining different parameters which usually require several and many times tedious steps in the chemical analysis. Therefore, due to increase in the number of samples and the need of fast and reliable techniques, the automation of many analytical procedures has recently given attention. Among the alternatives available to accomplish this purpose, flow methods have been proved to be suitable due to low sample and reagent consumption, high sample throughput and feasibility of their implementation.

Proposed in 1990 (Ruzicka and Hansen), the sequential injection analysis is based on the sequential aspiration of the sample and reagent(s) aliquots by using a multiport valve and a liquid propulsion unit, both interfaced to a computer. Its has been efficiently applied in process control and/or in the developed of analytical procedures.

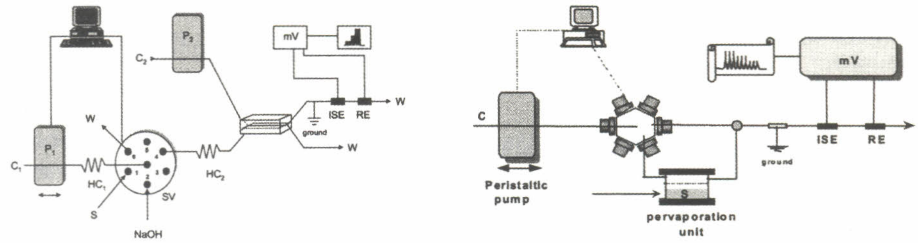


Figure 1 - Sequential injection system developed for volatile nitrogen determination. (a) Silage samples: S, sample (150 ml); NaOH, alkaline solution 3.0 mol l^{-1} (300 ml); HC_1 and HC_2, holding coil (3 ml and 50 cm, respectively); C_1 and C_2, carrier streams (H_2O and TRIS-HCl buffer solution 0,01 mol l^{-1}); ISE, ion selective electrode; RE; reference electrode; P1 and P2, peristaltic pumps and W, waste. (b) Soil samples.

MATERIAL AND METHODS

The sequential injection systems, schematically described in Figure 1a and 1b, were constructed using two peristaltic pumps with variable rotation (Ismatec, Switzerland) and a six-way electrically actuated solenoid valve (NResearch, USA), both interfaced to a computer through a PCL 711-S interface board (American Advantech, USA). The manifolds were built up with 0.8 mm i.d. polyethylene tubing. Tygon tubing was used for pumping the solutions. Ammonium tubular selective electrode (Alegret et al. 1989) was used as detector in both proposed procedures. The gaseous diffusion unit consisted of two Perspex pieces, with semi-tubular grooves drilled in each piece, closed by screws. Between the entrance and exit sides of the grooves was inserted a PTFE membrane that promoted the NH_3 separation of the sample solution. The pervaporation unit consisted of two Perspex chambers, donor and acceptor chamber, aligned by screws . Between the acceptor and donor chamber there are spaces that avoid the direct contact between membrane and the sample solution. Both separator devices involve a gaseous diffusion through a hydrophobic membrane. However in the gaseous diffusion unit there is a direct contact between the donor solution and the membrane, while it is not observed in the pervaporation unit. In the system proposed to volatile nitrogen determination in silage (Fig. 1a), sample and alkaline reagent aliquots are sequentially aspirated, mixed and then carried to a holding coil (HC_1). After, the sample zone formed in HC_1 was addressed to the gaseous diffusion unit, where the ammonia present in the donor chamber was diffused across the PTFE membrane. The diffused ammonia was collected by an acceptor stream that convert NH_3 to NH_4^+ and carried it toward the tubular ion selective and reference electrodes. In the system proposed to volatile nitrogen determination in soil, the solid sample is directly placed in the pervaporation donor chamber where alkaline solution is added. The ammonia formed diffused across the hydrofobic membrane and it was collected by an acceptor solution and directed to the potentiometric sensor.

RESULTS AND DISCUSSION

The main experimental parameters of the systems studied were optimized and the analytical characteristics were evaluated in relation to the precision, accuracy, sample throughput and detection limit. For soil samples it were observed r.s.d < 3.0 % (n=10); detection limit of 0.28 mg l^{-1} N and 15 samples h^{-1} as analytical frequency with 2.0 g of soil sample consume. For silage, the r.s.d was < 2.0 % (n=10); the detection limit was 3.0 mg l^{-1} N and the analytical frequency presented 30 samples h^{-1} with 150 ml of silage sample volume consume. Kjeldahl official procedure (AOAC

Table 1 - Volatile nitrogen content in soil and silage sample.

Sample	Silage (g kg^{-1} N)		Soil (g kg^{-1} N)	
	SIA	Kjeldahl	SIA	Kjeldahl
1	1.19 (± 0.03)*	1.16 (± 0.03)	0.42	0.35
2	6.15 (± 0.09)	6.79 (± 0.11)	0.70	0.63
3	4.92 (± 0.05)	6.10 (± 0.10)	0.02	0.02

* r.s.d. (n = 3)

1996), was used to certificate the accuracy of the sequential injection determination and, as observed in the Table 1, agreement results were obtained.

The sequential injection analysis can be considered a vanguard development of the traditional flow injection methods. Simplicity, versatility and robustness are the main characteristics offered by SIA instrumentation. The multiport valve used possibility different combinations of solutions and/or detectors around the single line configuration. Therefore two or more procedures can be adapted in the same configuration or the system fitted to a specific procedure of analysis. In comparison with traditional method, the determinations can be done with a low discharge generation and reagent consume and reduced step number. The pervaporation unit allowed the direct soil introduction without any previous treatment simplifying the determination.

REFERENCES

Ruzicka, J., Marshall, G.D. (1990). Sequential injection: A new concept for chemical sensors. Anal. Chim. Acta. 237:329-343.

Alegret, S., Alonso, J., Bartroli, J, Fábregas, E.M (1989). Flow injection system for on-line potentiometric monitoring of ammonia in freshwater streams. Analyst. 114:1443-1447.

AOAC (1996). Official methods of analysis of AOAC international. 16th ed., New York, 355p.

ID # 32-08

Bioeconomic model for decision-making on fattening beef-cattle

G. FERREIRA[1], O. CARDOZO[2] and J.M. SOARES DE LIMA[1]

[1]*Estación Experimental del Norte, Instituto Nacional de Investigación Agropecuaria Ruta 5, km 386, Tacuarembó, Uruguay, gferre@inia.gov.uy*

[2]*Estación Experimental Las Brujas, Instituto Nacional de Investigación Agropecuaria C.C. 33085 Las Piedras, Canelones, Uruguay.*

ABSTRACT

Profitability and competitiveness of agricultural systems it is closely related with the technology used. Economic and financial appraisal of investments on pasture improvements, facilities, feed and management plans, etc. are often required in order to make decisions. A bio-economic simulation model was developed in order to support decision making on beef-cattle grazing fattening. The aim of the model is to show the relationship between the technological alternative analysed in physical terms as well as financial and economic. By this way it is possible to asset and relate the bio-economic impact of the different animal and pasture management alternative technologies. Results show that the model could be used to support decision making when using stocking rates between 0.8 and 2.5 heads/ha.

KEYWORDS: Models, bio-economic, production systems, livestock, decision support

INTRODUCTION

Decision making at farm level is a complex, dynamic and evolutionary process. Good information is a key element in order to analyse and make more well-informed decisions (Mc Grann , 1991; Mc Grann *et al* 1999). Therefore, information as other resources need to be managed in order to become usefull. A Bioeconomic model for decision-making on beef-cattle grazing fattening was developed in Uruguay with the objective of: i. Formulate a computer model that can be used for researchers, technical advisers and farmers in order to evaluate and plan different productive alternatives for grazing livestock beef-cattle fattening as well as to quantify the effects that this alternative promotes; ii. Offer a tool that allows users to do an economic and financial analysis of the different alternatives, supporting the user in the identification of options that produce increments in efficiency and income and decrease risk; iii. Demonstrate that nowadays the computer and information science are a very useful technology to support the tasks of planning, implementation and control of different alternatives of production and research; iv. Indicate the advantages of model experimentation, before developing field trials, with the purpose of exploring a very wide spectrum of possibilities that allow to orient and to identify relevant products for research.

MATERIAL AND METHODS

Using a spreadsheet (MS. Excel 97 SR-2) and spreadsheet compiler (Visual Baler, Ver 2.0) a Windows environment bioeconomic model was developed on the basis of