Some data about the technical beet quality in the Mediterranean area

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SUMMARY

The internal technical quality of sugar beet delivred to the Moroccan sugar factories has been studied during the last sugar campaigns in three factories localized in two different areas. The high concentrations in sodium (usually about 30 mmol/100 g sugar), as well in nitrogen compounds and invert sugar (more than 2 g/100g sugar) can be considered as a characteristic of this beet. A comparison with data from factories in south of Spain and Italy and in Greece shows a similar situation. The beet storage in the Mediterranean countries after harvesting under summer's temperature which can reach 40°C in Morocco together with the nitrogen fertilization are responsible of this situation, while other parameters in relation with the climate could also play a role. In the Mediterranean area, more than in other regions, the harmful effect of nitrogen should not be given only as alpha -nitrogen value but in term of proportions of different nitrogen fractions such alpha-nitrogen, nitrogen from amids and betaïn because the concentrations of these elements should not be influenced in the same way by the dry Mediterranean climate. A measure of total nitrogen by Kjeldahl method, the alpha nitrogen by blue number technique, the nitrogen from amids by distillation after hydrolysis and betain by HPLC gives these proportions. Using the same methods, the contribution of amino-acids to decrease the juice's alkalinity is shown with an example of one Moroccan sugar beet factory.

RESUME

La qualité technologique interne de la betterave sucrière livrée aux sucreries Marocaines a été étudiée ces dernières années dans deux régions betteravières ; les concentrations en sodium, en composés azotés et en sucres réducteurs constituent des caractéristiques essentielles de cette betterave. La comparaison avec les sucreries du sud de l'Espagne, de l'Italie et de la Grèce montre une grande analogie. Le séjournement de la betterave après arrachage dans les pays méditerranéens explique en bonne partie cette qualité de betterave tandis que la fertlisation azotée constitue l'autre paramètre important. Toutefois, d'autres facteurs seraient à considérer. La nuisance de l'azote ne devrait pas être prise en terme de valeur d'azote alpha aminé surtout mais en terme de proportion des divers composés azotés (azote total, fonction en alpha, fonction amide et bétaïne) puisque dans des pays à climat chaud, la synthèse des amides et de la bétaïne devrait être plus favorisée. La notion d'alcalinité des jus et sa relation avec la qualité de la betterave est également discutée à travers un exemple dans une sucrerie Marocaine.

INTRODUCTION AND OBJECTIVES

* **to study the influence of nitrogen fertilization and beet storage on the technological quality**

* **to show the important parameters in the mediterranean beet quality**

MATERIEL AND METHODS

- **BEET TRIALS :**

  * **NITROGEN FERTILIZATION : comparison of two nitrogen fertilizer amounts (R : used in the region - C : calculated after preliminary soil analysis)**

  * **BEET STORAGE**

- **SAMPLES FROM FACTORIES :** * **BEET SLICED**
  * **PROCESSING JUICES**
  * **MOLASSES**

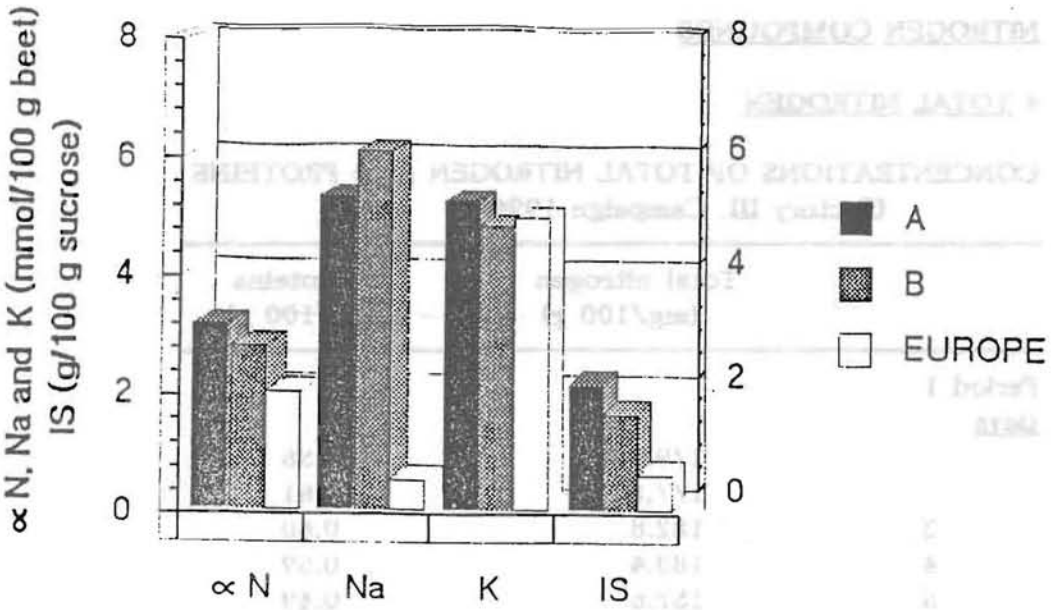
- **PROCESSING PARAMETERS INSIDE THE FACTORIES**

WE HAVE CONSIDERED :

- **CONVENTIONAL ELEMENTS (SODIUM, POTASSIUM, ALPHA NITROGEN, INVERT SUGAR)**

- **NO CONVENTIONAL ELEMENTS (N-AMIDS, PROTEINS, POLYSACCHARIDS AND BETAIN)**

RESULTS AND DISCUSSIONS



BEET COMPOSITION FOR TWO FACTORIES IN TWO REGIONS A AND B
(Mean composition for periods studied during 3 campaigns).
COMPARISON WITH EUROPEAN DATA

BEET COMPOSITION IN FACTORY III (CAMPAIGN 1996)

Dry Sub (%)	Sugar (%)	alpha-N mmol/100g	N-amid mg/100 g	Na mmol /100 g	K	Na / K
23.58	15.02	3.34	15.28	5.35	4.13	1.3

SOME DATA ABOUT BEET COMPOSITION IN SPAIN AND ITALY

	Sucrose (%)	Na (mmol /100 g Beet)	K	∝N
ITALY				
North	15.92	1.66	4.82	3.21
South	15.70	3.60	8.08	4.50
SPAIN				
North	15.31	1.87	5.05	2.39
South	16.91	4.61	5.86	3.75

NITROGEN COMPOUNDS

* TOTAL NITROGEN

CONCENTRATIONS OF TOTAL NITROGEN AND PROTEINS
(Factory III, Campaign 1996)

	Total nitrogen (mg/100 g)	Proteins (g/100 g)
Period 1		
Days		
1	179.0	0.56
2	177,5	0.61
3	182.8	0.60
4	183.4	0.59
5	157.6	0.49
6	168.2	0.51
7	184.1	0.64
Mean value =	176.1	0.57
Period 2		
Days		
1	193.6	0.62
2	179.3	0.55
3	166.8	0.47
4	176.1	0.54
5	185.1	0.53
Mean value =	180.2	0.54

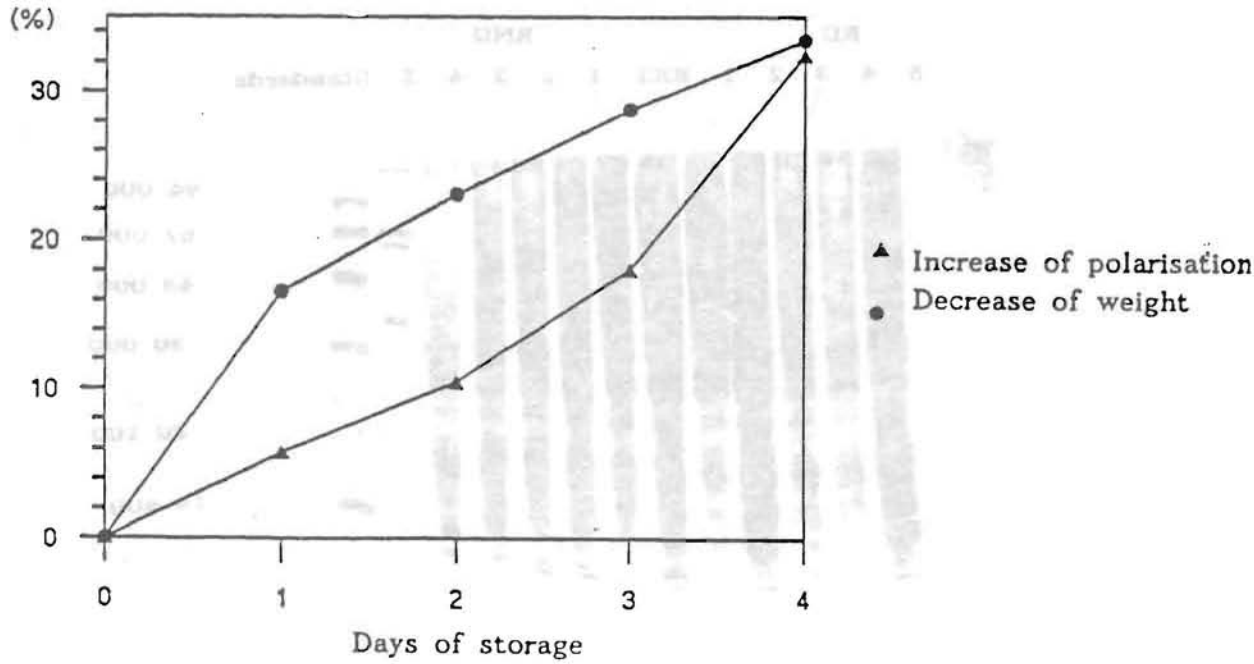
PROTEINS

Quantity : by Kjeldahl total nitrogen (coefficient 6,25)

Quality : by electrophoresis (PAGE)

For the beet sliced, the PAGE shows 6-8 proteins fractions with molecular weight between 16 000 and 86 000 daltons.

The proteins hydrolysis can occur during storage under high temperatures :



LOSS OF WATER DURING BEET STORAGE

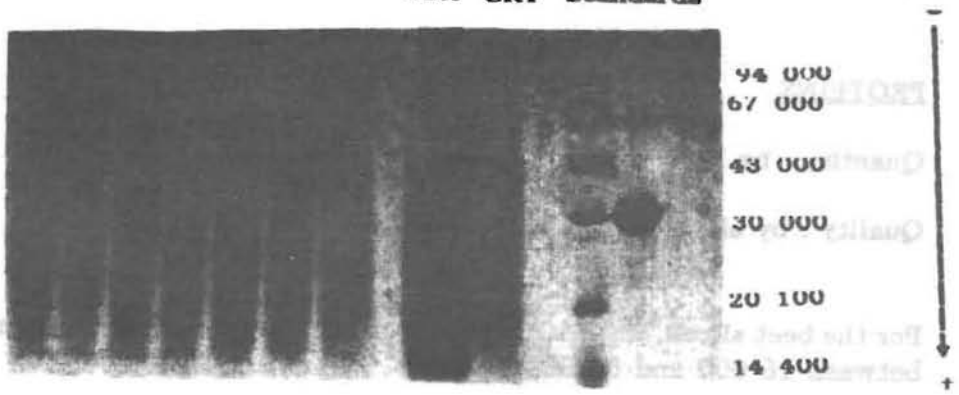
The PAGE can be used to show the protein degradation and the influence of nitrogen fertilizer during storage :

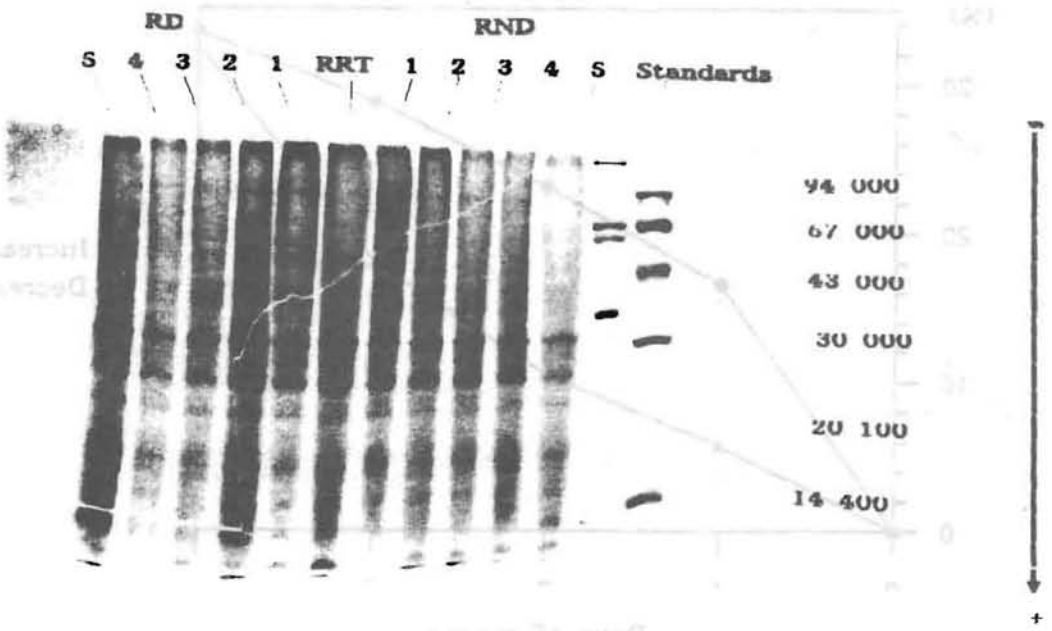
- Nitrogen fertilizer supplied : R

RD : beet storage for 5 days without top
RND : beet storage for 5 days with top
RRT : beet at harvesting

- Nitrogen Fertilizer supplied : C

CD : beet storage for 5 days without top
CND : beet storage for 5 days with top
CRT : beet at harvesting


RRT CRT Standards
94 000
67 000
43 000
30 000
20 100
14 400
-
+


RD
RND
S 4 3 2 1 RRT 1 2 3 4 S Standards
94 000
67 000
43 000
30 000
20 100
14 400
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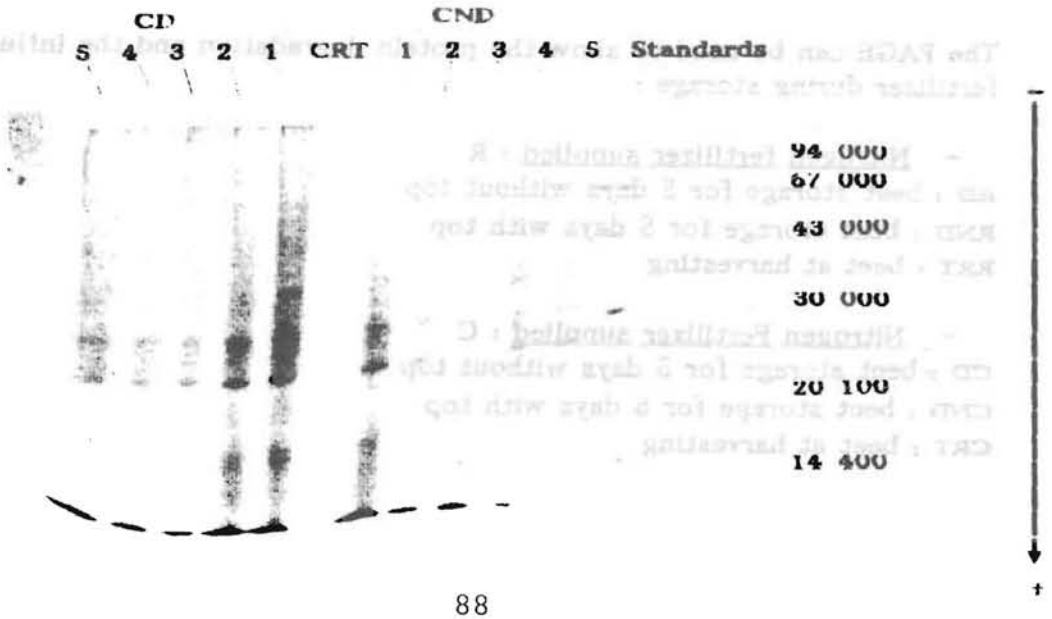
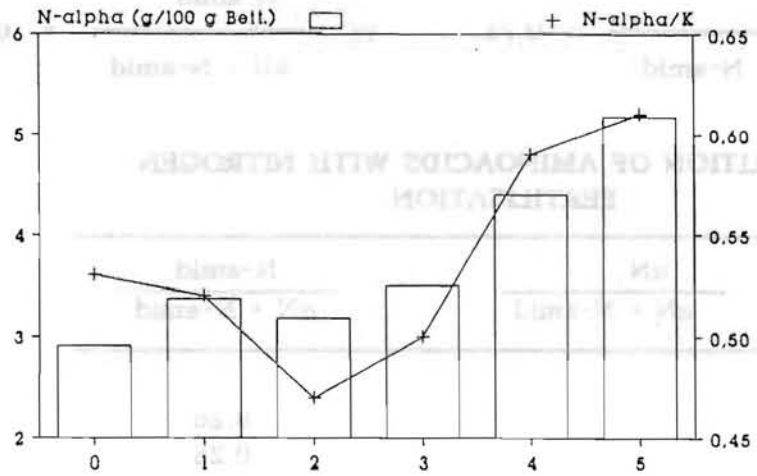

CD
CND
S 4 3 2 1 CRT 1 2 3 4 S Standards
94 000
67 000
43 000
30 000
20 100
14 400
-
+

* ALPHA AMINO NITROGEN

RATIO ALPHA N/TOTAL NITROGEN FOR DIFFERENT FACTORIES

Factory I (campaign 1992)	0.23
Factory II (campaign 1992)	0.19
Factory III (campaign 1996)	0.26

The alpha amino nitrogen concentration depends on N-fertilization and beet storage after harvesting.



ALPHA NITROGEN CONCENTRATION DURING BEET STORAGE

RATIO ALPHA N/TOTAL NITROGEN FOR DIFFERENT N-AMOUNT SUPPLIED

	Nitrogen Fertilizer (Kg/ha)				
	0	65	180	240	340
Total nitrogen (mg/100g beet.)	122.0	126.0	142.0	146.0	170.0
Increase (%)		3.3	12.7	2.8	16.4
Alpha Nitrogen (mg/100g beet.)	23.7	28.9	36.8	44.2	46.9
Increase (%)		21.9	27.3	20.1	6.1
αN/NTK	0.19	0.23	0.26	0.30	0.28

*** NITROGEN FROM AMIDS :**

$$\frac{\alpha N}{\alpha N + N\text{-amid}} = \text{proportion of amino-acids nitrogen in form alpha}$$

$$\frac{N\text{-amid}}{\alpha N + N\text{-amid}} = \text{proportion of amino-acids nitrogen in form amid}$$

$$\text{PERCENTAGE OF AMIDS} = 2 \times \frac{N\text{-amid}}{\alpha N + N\text{-amid}}$$

IN SUGAR FACTORY III :

$$\frac{\alpha N}{\alpha N + N\text{-amid}} = 0.76 \quad \text{et} \quad \frac{N\text{-amid}}{\alpha N + N\text{-amid}} = 0.24$$

EVOLUTION OF AMINOACIDS WITH NITROGEN FERTILISATION

	$\frac{\alpha N}{\alpha N + N\text{-amid}}$	$\frac{N\text{-amid}}{\alpha N + N\text{-amid}}$
Region A		
R	0.74	0.26
C	0.75	0.25
Region B		
R	0.67	0.33
C	0.67	0.33

EVOLUTION OF AMINOACIDS DURING BEET STORAGE

$\frac{\alpha N}{\alpha N + N\text{-amid}}$

	storage days					
	0	1	2	3	4	5
Region A	0.74	0.80	0.78	0.79	0.81	0.81
Region B	0.67	0.68	0.65	0.66	0.69	0.69

$\frac{N\text{-amid}}{\alpha N + N\text{-amid}}$

Region A	0.27	0.20	0.23	0.21	0.20	0.20
Region B	0.34	0.32	0.36	0.35	0.31	0.32

* **BETAIN**

Concentration : 0.18 % in beet
2.97 - 4.32 % in molasses

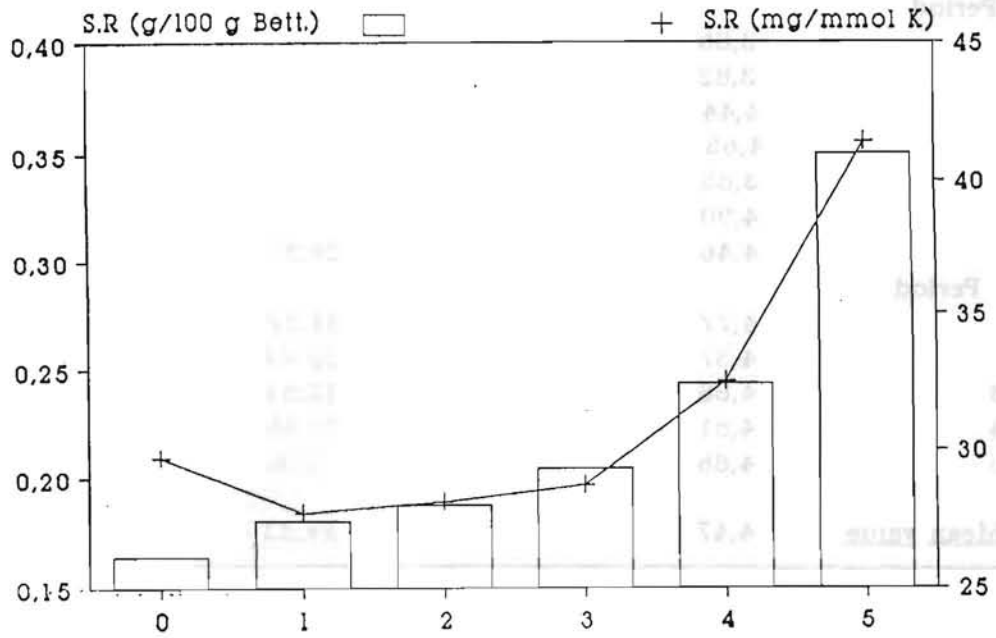
MOLASSES COMPOSITION FOR DIFFERENT FACTORIES

	Purity (%)	K (%)	Na (%)	(K+Na)/NS mmol/100g	N (%)	Betain (%)	Ra (%)
MOROCCO							
Factory I 1992 (1)	60.42	2.82	1.68	462	1.55	3.05	0.69
Factory I, 1992 (2)	59.01	2.17	2.09	446	1.55	3.11	0.74
Factory II 1992 (1)	61.49	2.77	2.15	533	1.53	4.32	0.80
Factory II 1992 (2)	60.13	1.87	2.44	483	1.49	3.01	0.68
Factory II 1992 (3)	60.88	1.96	2.08	449	1.58	2.97	0.67
Factory IV 1992	59.88	2.95	2.09	518	1.49	3.12	0.62
SPAIN							
Factory 1, 1992 I	59.90	3.23	2.06	537	1.60	3.30	0.68
SYRIA	62.54	2.75	2.45			2.74	0.29
GERMANY							
Factory 1, 1991 I*	58.30	2.75	0.34	255	2.10	4.90	1.72
Factory 1, 1991 II	65.50	3.39	0.94	462	1.78	5.02	1.94
Factory 1, 1991 III	61.75	3.76	0.54	391	2.04	5.95	1.92

* : Molasses Quentin Ra : Raffinose

INVERT SUGAR

The invert concentrations are due to nitrogen fertilization and beet storage after harvesting :



INVERT SUGAR CONCENTRATION DURING BEET STORAGE

SODIUM AND POTASSIUM :

Where does come from the higher sodium concentrations ?

-FROM SOIL ?

-FROM WATER COMPOSITION ?

-FROM STRESS ?

-FROM NITROGEN SUPPLY ?

INFLUENCE ON THE PROCESS ?

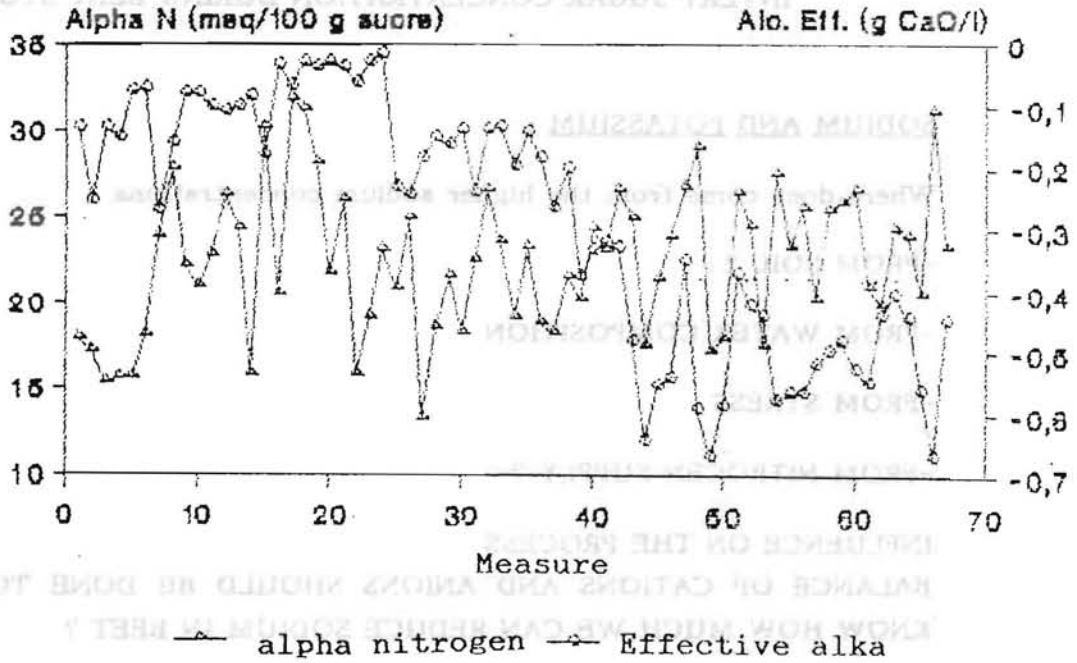
BALANCE OF CATIONS AND ANIONS SHOULD BE DONE TO KNOW HOW MUCH WE CAN REDUCE SODIUM IN BEET ?

OTHER NON CONVENTIONAL ELEMENTS

TOTAL POLYSACCHARIDS IN BEET (FACTORY III, CAMPAIGN 1996)

	g/100 g Beet	g/100 g sucrose
Days		
Period 1		
1	3,86	26,38
2	3,82	26,11
3	4,44	29,42
4	4,65	31,21
5	3,85	27,25
6	4,90	32,41
7	4,46	29,87
Period 2		
1	4,77	31,12
2	4,37	28,90
3	4,88	32,53
4	4,81	30,66
5	4,86	32,08
Mean value	4,47	29,83

Relation between technical quality and effective alkalinity :



EFFECTIVE ALKALINITY AND ALPHA NITROGEN CONCENTRATION (Factory III, CAMPAIGN 1996)

SUMMARY

TECHNOLOGICAL BEET QUALITY IN MEDITERRANEAN AREA :

* HIGH INVERT SUGAR

* VERY HIGH SODIUM CONTENTS

* HIGH ALPHA NITROGEN CONCENTRATIONS

  WHAT ABOUT AMIDS AND PROTEINS ?

* BETAIN : LOWER CONCENTRATION ?

* POLYSACCHARIDS : NORMAL CONCENTRATION ?

  INFLUENCE ON THE PROCESS ?

CONCLUSIONS

MORE STUDIES SHOULD BE DONE ON THE MEDITERRANEAN BEET IN ORDER TO HAVE BETTER DEFINITION OF ITS TECHNOLOGICAL QUALITY.

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