ALMA MATER STUDIORUM - **UNIVERSITÀ DI BOLOGNA**
DIPARTIMENTO SCIENZE MEDICHE VETERINARIE

IMPIEGO DELLA CLINOPTILOLITE NELL'ALLEVAMENTO DELLA BOVINA DA LATTE

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SOCIETÀ ITALIANA DI BUIATRIA
per la salute, il benessere, le produzioni del bovino

ARGILLE: COSA SONO?

Le argille sono composti inorganici che possono essere suddivise in due gruppi in funzione della struttura:

1 - Phillosilicati, che hanno una struttura lamellare e comprendono le bentoniti, le caoliniti e le sepioliti;

2 - Tectosilicati, che possiedono una struttura tridimensionale e comprendono le zeoliti.

Cosa sono le zeoliti ed in particolare la CLINOPTILOLITE?

ZEOLITI

Sono zeoliti tutte quelle sostanze inorganiche cristalline che presentano capacità di scambio ionico selettivo a bassa temperatura.

Sono ALLUMINO-SILICATI IDRATATI di elementi alcalini (sodio, potassio) e alcalino-terrosi (calcio ecc..)

Il nome zeolite deriva dai greci (zein=bollire e litos=pietra). Esistono più di 50 tipi diversi di zeoliti naturali, diffuse sulla terra (Giappone, USA, Cuba, Slovacchia, Grecia, ecc…)

ZEOLITI

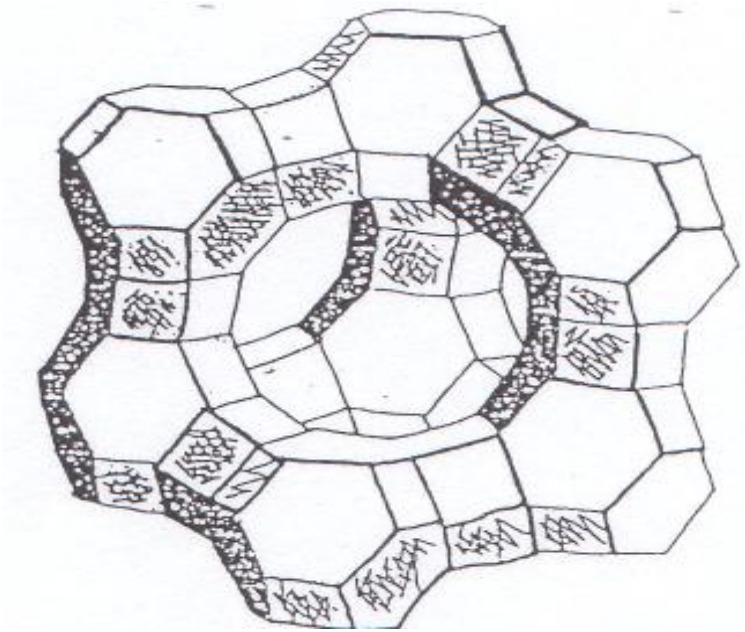
Le zeoliti non sono tutte uguali:

Esistono giacimenti di tipo roccioso e di tipo tufaceo (come in Italia).

La roccia ed il minerale che contiene sono indicati con lo stesso nome ma in realtà sono presenti altri composti.

E’ sempre bene conoscere la purezza della roccia poiché sono presenti sempre altri composti come feldspati, calcite, rulite, apatiti ecc…

CLINOPTILOLITE



CLINOPTILOLITE

Zeolite tabulare non fibrosa, caratterizzata dalla presenza di ampie cavità comunicanti tra di loro e con l'esterno mediante canali di dimensioni variabili da 2,6 a 7,4 Å.

La **CLINOPTILOLITE** è un **minerale naturale** di origine vulcanica con struttura tridimensionale costituita da innumerevoli tetraedri di silice.
Non è una roccia inerte: le sue innumerevoli cavità contengono dei cationi (Na, K, Ca, Mg) che possono essere scambiati con l'esterno.
100 grammi = superficie come campo da calcio!!

CLINOPTILOLITE

I cationi sono legati all'interno ma sono facilmente "ceduti" e scambiati con altri (Capacità di Scambio Ionico).
Questa capacità consente di adsorbire (e scambiare) sostanze diverse ma in particolare la **Clinoptilolite è selettiva per alcune sostanze** quali:

Ione ammonio (NH_4) – Ammoniaca **-**, **metalli pesanti**, metalli alcalini e alcalino-terrosi, **micotossine**

APPLICAZIONE DELLE ZEOLITI

Per le loro forti capacità di Scambio Ionico trovano impiego in diversi campi:

Trattamento delle acque, agricoltura (orticoltura), vivaistica, industria petrolifera, controllo cattivi odori, ma soprattutto in zootecnia ed acquacoltura.

Per le sue caratteristiche di purezza (80-85%) la Clinoptilolite è la miglior zeolite impiegata in alimentazione animale

ZEOLITE: l'adiuvante perfetto

Nuove frontiere nell'utilizzo di sostanze naturali per contrastare lo stress ossidativo

conferenza a cura del Prof. Manna dell'Università "La Sapienza" di Roma

La conseguenza della presenza di un eccesso di radicali liberi nell'organismo è l'attacco di alcune strutture cellulari con conseguenti danni funzionali che, se non eliminati, possono provocare l'insorgenza di varie patologie e l'accelerazione dei processi di invecchiamento.

Anche nell'attività sportiva c'è produzione di radicali liberi che limitano la resa atletica perché accompagnati dalla presenza a livello muscolare di una quantità rilevante di acido lattico.

La zeolite rientra tra gli strumenti importanti per combattere e neutralizzare i radicali liberi.

ZEOLITE: l'adiuvante perfetto

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Oggi la zeolite è classificata (GMDN General Medical Device Nomenclature) come dispositivo medico e definita come segue :

Sostanze ad uso orale adatte ad assorbire/chelare e rimuovere sostanze dannose e tossiche nel tratto gastro-intestinale (es. metalli pesanti, nitrosamine, ammonio, micotossine, cationi, pesticidi) riducendone l'assorbimento da parte dell'organismo. **Possono anche funzionare come antiossidanti catturando radicali liberi e riducendo la formazione di ROS** (reactive oxygen species).

le sue caratteristiche strutturali le consentono di esplicare alcune attività utili per l'organismo:
- ridurre l'ammoniaca nell'organismo
- legare, mediante scambio cationico, i metalli pesanti eliminandoli;
- adsorbire tossine inattivandole;
- salvaguardare l'organismo dai danni dei radicali liberi attraverso la sua capacità antiossidante.

E' associabile ad altri composti: non sono state rilevate interazioni con altri prodotti o farmaci. **La sua utilizzazione come additivo alimentare, ampiamente sperimentata sugli animali, ha dimostrato i notevoli benefici effetti sulla salute**, in assenza di tossicità o di reazioni avverse anche in associazione con altre sostanze;

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ORIGINAL ARTICLE

Effects of clinoptilolite treatment on oxidative stress after partial hepatectomy in rats

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KEYWORDS
clinoptilolite;
oxidative stress;
partial hepatectomy

Summary *Background/Objective*: Clinoptilolite is a natural zeolite crystal. Cytoprotective effects of clinoptilolite have been reported. However, so far there are no data about the effects of clinoptilolite treatment on oxidative stress after partial hepatectomy. In this experimental study, the effects of clinoptilolite treatment after partial hepatectomy on oxidative stress were evaluated.
Methods: There were four experimental groups ($n = 8$): Group S, the sham group; Group H, the hepatectomy group; Group HC, the clinoptilolite treatment after partial hepatectomy group; and Group CS, the clinoptilolite-treated sham group. A 70% partial hepatectomy was performed for Group H and HC. Clinoptilolite (5 mg/kg) was given to the rats orally (via gavage tube) twice a day for 10 days after hepatectomy. Malondialdehyde (MDA), Cu-Zn super oxide dismutase (SOD), and glutathione (GSH) levels were assessed to evaluate oxidative stress.
Results: Plasma and liver tissue MDA levels of Group HC were significantly lower than the H group ($p = 0.018$ and $p = 0.000$, respectively). Liver tissue Cu-Zn SOD activity and GSH levels of Group HC were significantly higher than Group H ($p = 0.003$, $p = 0.007$, respectively).
Conclusion: Clinoptilolite administration reduces oxidant activity and supports antioxidant response after partial hepatectomy.

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ORIGINAL RESEARCH

Clinical evidence supporting the use of an activated clinoptilolite suspension as an agent to increase urinary excretion of toxic heavy metals

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Abstract: Effective treatment of chronic illness resulting from the long-term buildup of heavy metals in the body, such as chelation therapy, presents numerous clinical challenges, including undesirable side effects and unpredictable efficacy. Use of a naturally occurring zeolite, clinoptilolite, to remove these toxic substances may offer an efficacious and safe alternative to the traditional approaches. This study was designed to evaluate the ability of activated clinoptilolite suspended in water (ACS) to remove heavy metals from the body through urinary excretion without the undesirable removal of physiologically important electrolytes. The protocol utilized two treatment groups, each consisting of eleven healthy men aged 36 to 70 years. Volunteers were given a commercially available version of the study substance for seven days (Group 1) and 30 days (Group 2) and urine samples were collected at specified time points in the study. Changes in urinary concentration of the heavy metals were measured by inductively coupled plasma mass spectrometry and compared to the baseline. Also, serum samples were obtained from five individuals in each group and serum electrolytes were measured prior to and after taking the product. Participants in both groups had increased concentrations of heavy metals in the urine with the peak excretion at around day 4. No clinically significant alterations in serum electrolyte levels were seen at either seven or 30 days on ACS. In conclusion, this study demonstrates that the daily use of an activated clinoptilolite suspension represents a potentially safe and effective way to remove toxic heavy metals from the body through increased urinary excretion without removing clinically detrimental amounts of vital electrolytes.

Keywords: zeolite, clinoptilolite, heavy metals, toxins, atomic absorption spectroscopy

Introduction

In the past few years there has been a growing recognition that in contradistinction to the rare occurrence of acute heavy metal toxicity, illness due to the chronic accumulation of metals, such as lead, mercury, arsenic, cadmium, and aluminum is far more common than ever suspected. Because the accumulation of these metals takes place over months or years, there are frequently no acute effects, and because the symptoms are usually quite non-specific, only the astute clinician suspects chronic metal poisoning.

The slow accumulation of heavy metals has been implicated in numerous neurological diseases, including autism and attention-deficit hyperactivity disorder,[1,2] encephalopathy,[3] Parkinson's disease,[4] and Alzheimer's disease.[5,6] Furthermore, specific links have been made between lead and mercury accumulation and the development of learning disorders other than autism spectrum disorders.[7] In addition, cardiovascular diseases, such as hypertension and cardiac rhythm disorders, have been

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ORIGINAL PAPER

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M. Colic · M. Poljak-Blazi

Immunostimulatory effect of natural clinoptilolite as a possible mechanism of its antimetastatic ability

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Abstract *Purpose*: Many biochemical processes are closely related to ion exchange, adsorption, and catalysis. Zeolites reversibly bind small molecules such as oxygen or nitric oxide; they possess size and shape selectivity, the possibility of metalloenzyme mimicry, and immunomodulatory activity. These properties make them interesting for pharmaceutical industry and medicine. *Methods*: The experiments were performed on mice. Different biochemical and molecular methods were used. *Results*: Micronized zeolite (MZ) administered by gastric intubation to mice injected with melanoma cells significantly reduced the number of melanoma metastases. In mice fed MZ for 28 days, concentration of lipid-bound sialic acid (LSA) in serum increased, but lipid peroxidation in liver decreased. The lymphocytes from lymph nodes of these mice provoked a significantly higher alogeneic graft-versus-host (GVH) reaction than cells of control mice. After i.p. application of MZ, the number of peritoneal macrophages, as well as their production of superoxide anion, increased. However, NO generation was totally abolished. At the same time, translocation of p65 (NFκB subunit) to the nucleus of splenic cells was observed. *Conclusion*: Here we report antimetastatic and immunostimulatory effect of MZ and we propose a possible mechanism of its action.

Keywords Micronized zeolite · Clinoptilolite · Oxidative stress · Immunostimulation · T-lymphocyte NFκB

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Introduction

Zeolites are hydrated natural and synthetic microporous crystals with well-defined structures containing AlO_4 and SiO_4 tetrahedra linked through the common oxygen atoms (Breck 1964). Zeolites have properties to act as catalysts, ion-exchangers, adsorbents, and detergent builders (Colella 1999; Garces 1999; Flanigen 1980; Naber et al. 1994; Sersale 1985). Apart from being extensively used in different industrial applications, it is known that silicates and aluminosilicates also possess either positive or negative biological activity. Well-defined structures and catalytic activity make aluminosilicates an attractive model system for protein and enzyme mimetics (Bedioui 1995). Recent results have demonstrated that zeolite was very effective as a glucose adsorbent (Concepcion-Rosabal et al. 1997) as well as a potential adjuvant in anticancer therapy (Pavelic et al. 2001). Zeolites reversibly bind small molecules such as oxygen or nitric oxide, they possess size and shape selectivity, the possibility of metalloenzyme mimicry, and immunomodulatory activity (Ozesmi et al. 1986).

Accumulating evidence has indicated that zeolites play an important role in regulation of the immune system. It was reported that silica, silicates, and aluminosilicates act as non-specific immunostimulators similarly to superantigens (Ueki et al. 1994). Superantigens (SAG) are a class of immunostimulatory and disease-causing proteins of bacterial and viral origin with the ability to activate a relatively large fraction (5–20%) of the T cell population. Activation requires simultaneous interaction of the SAG with the Vβ domain of T cell complex (MHC) class II molecules on the surface of antigen-presenting cells (Ueki et al. 1994). Pro-inflammatory macrophages, that belong to class II MHC antigen-presenting cells, are activated by fibrinogen silicate particulate (Allison et al. 1996; Drumm et al. 1998).

It was shown that exposure of alveolar macrophages to silicate particles leads to activation of mitogen-activated protein kinases (MAPK), protein kinase C, and

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Research Section

The effect of the zeolite clinoptilolite on serum chemistry and hematopoiesis in mice

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Abstract

Zeolites are natural or synthetic crystalline alumosilicates with ion exchanging properties. Supplied in fodder, they promote biomass production and animal health. Our aim was to assess the effects of the natural zeolite, clinoptilolite, on hematopoiesis, serum electrolytes and essential biochemical indicators of kidney and liver function in mice. Two preparations differing in particle size were tested: a powderized form obtained by countercurrent mechanical treatment of the clinoptilolite (MTCp) and normally ground clinoptilolite (NGCp). Young adult mice were supplied with food containing 12.5, 25 or 50% clinoptilolite powder. Control animals received the same food ration without the clinoptilolite. After 10, 20, 30 and 40 days, six animals from each group were exsanguinated to obtain blood for hematological and serum for biochemical measurements as well as to collect femoral bone marrow for determination of hematopoietic activity. Clinoptilolite ingestion was well tolerated, as judged by comparable body masses of treated and control animals. A 20% increase of the potassium level was detected in mice receiving the zeolite-rich diet, without other changes in serum chemistry. Erythrocyte, hemoglobin and platelet levels in peripheral blood were not materially affected. NGCp caused leukocytosis, with concomitant decline of the GM–CFU content in the bone marrow, which was attributed to intestinal irritation by rough zeolite particles. The mechanically treated clinoptilolite preparation caused similar, albeit less pronounced, changes. In a limited experiment, mice having transplanted mammary carcinoma in the terminal stage showed increased potassium and decreased sodium and chloride levels, severe anemia and leukocytosis, decreased bone marrow cellularity and diminished content of hematopoietic progenitor cells in the marrow. The clinoptilolite preparations ameliorated the sodium and chloride decline, whereas the effects on hematopoiesis were erratic.

Keywords: Zeolites; Clinoptilolite; Mice; Mammary carcinoma; Serum electrolytes; Hematopoiesis

1. Introduction

Zeolites are crystalline, hydrated aluminosilicates having a fine network of structural cavities. They selectively adsorb water and exchange cations (Nagy et al. 1998; Mumpton, 1999). Zeolites have found multifarious applications as adsorbents, ion exchangers and catalysts in industry, agriculture, veterinary medicine, sanitation and environmental protection. Biological applications include the removal of ammonia from wastewater and animal manure (Bernal and Lopez-Real, 1993) air filtration and deodoration (Miner, 1980), soil amelioration and fertilization (Mumpton, 1999).

Animal fodder containing zeolites has been shown to increase biomass production in fisheries, to promote weight gain of chicken (Fethiere et al., 1994), swine (Ward et al., 1991) and sheep (Eady et al., 1980), to improve the quality of animal products such as eggs (Keshavarz and McCormick, 1991) or wool (Eady et al.,

Abbreviations: CEC, cation exchange capacity; DPD, 3,5-dichlorophenyldiazonium tetrafluoroborate; EDTA, ethylenediaminetetraacetic acid; GM, granulocyte-macrophage; GM–CFU, granulocyte-macrophage colony-forming unit; Hb, hemoglobin; IMDM, Iscove's modified Dulbecco's medium; MCV, mean cell volume; MCH, mean cell hemoglobin; MCHC, mean cell hemoglobin concentration; MPV, mean platelet volume; MTCp, mechanically treated clinoptilolite; NGCp, normally ground clinoptilolite; Plt, platelets; RBC, red blood cells; WBC, white blood cells.

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REMOVAL OF AMMONIA BY CLINOPTILOLITE

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ABSTRACT

The important advantage of zeolite applied to water treatment is its high porosity when comparing to other minerals. The porosity results in good hydrodynamic properties (the increase in the pressure loss on the zeolite filters is 1.5-2.0 times smaller than in the case of sand filters) and adsorption roperties, and in turn high capacity which allows for adsorption of contaminants (a clinoptilolite filter allows for removal of phytoplankton and bacteria).

The increase in the application of artificial fertilizers and gradual contamination of water resulted from discharging industrial wastewater into the environment led to the contamination of the environment by nitric compounds. Wastewater contains about 15-50 mg dm^{-3} of nitric compounds (based on nitrogen) – ammonia salts constitute about 55-60% whereas organic forms of proteins, pesticides and aminoacids about 40-50%.

Natural clinoptilolite could be applied to remove ammonium ions from water and wastewater. The ammonium ion uptake behaviour of clinoptilolite is connected to the processes of ion exchange. The main aim of this investigation is to evaluate the adsorption capacity of clinoptilolite towards ammonium ions. According to the obtained results the adsorption capacity of clinoptilolite for the removal of ammonium ions demonstrates its potential application in the treatment of water, wastewater and sanitary landfill leachate contaminated with ammonia. The highest adsorption capacity of clinoptilolite towards ammonium ions of 3.79 mg g^{-1} was found for the initial concentration of 300 mg L^{-1}. The highest removal level reached by clinoptilolite for ammonium was of 99.74% for the initial concentration of ammonia of 50 mg L^{-1}. The effect of exposure time on maximum uptake of ammonia was found to be insignificant.

KEYWORDS: clinoptilolite; ammonium ion removal; ion exchange.

INTRODUCTION

Zeolites possess a net negative structural charge resulting from isomorphic substitution of cations in the crystal lattice (Faghihian and Bowman, 2005). Minerals from the zeolite group differ from one another in the content of Si and Al. Clinoptilolite is the most common and abundant high-siliceous zeolite. The ratio of Si/Al in clinoptilolite is 5.7. Clinoptilolite belongs to the heulandite group. It has a two-dimensional channel system that allows the mineral to act as a molecular sieve (Bowman, 2003; Sullivan *et al.,* 1998). Moreover, this zeolite shows high sorption and ion-exchange capacity, ion-exchange selectivity, catalytic activity and structural temperature stability up to 700-750°C (Zabochnicka-Swiatek and Stepniak 2008).

The increase in the concentration of nitric compounds in aquifers results from the application of artificial fertilizers, and also is caused by discharging contaminated water from various industrial processes. Clinoptilolite shows highly selective capacity of adsorption towards N-NH4+, and thus can be applied to remove ammonia from wastewater (Sprynskyy, 2005). The mechanism of ammonia nitrogen removal by means of clinoptilolite is based on the ion-exchange with the cations of an ion-exchanger. Ammonia nitrogen can be also removed through adsorption in the skeletal pores of the zeolite. The extraction degree increases inversely proportional to the reduction of the

CLINOPTILOLITE

In alimentazione animale si sono visti risultati non solo sulle performance degli animali ma anche interessanti aspetti sull'ambiente.

Estremamente efficace nell'abbattimento di odori e nel miglioramento qualitativo in termini di fertilizzante del terreno.
Cede lentamente l'azoto dei liquami al terreno, depura i liquami da eventuale presenza di metalli fitotossici presenti, blocca la lisciviazione degli elementi, rilascia microelementi in modo controllato.

CLINOPTILOLITE

Efficace “insetticida” in polvere

Conservante di cereali e mangimi:
la funzione insetticida si esplica sugli individui adulti intaccando le membrane intersegmentali provocandone la morte in 36-48 ore. (6° Conferenza Internazionale Protezione Derrate Immagazzinate, Australia, 1995).

Importante utilizzo nei silos per prevenire le muffe!!

CLINOPTILOLITE NEI BOVINI DA LATTE

Interessanti applicazioni per migliorare l'ambiente ruminale ed intestinale.

Le ricerche hanno evidenziato anche aspetti positivi sulla qualità del latte, sul sequestro di micotossine con riduzione assorbimento e sui parametri del rumine (Università di Milano e Piacenza).

CLINOPTILOLITE E QUALITA' LATTE

(Sciaraffia e coll., Univ. Milano)

	CONTROLLO	CLINOPTILOLITE
PROTEINE %	3,45	**3,52**
GRASSO %	2,95	**3,50**
LATTOSIO %	5,14	5,19
PRODUZIONE l/giorno	34,3	34,1
UREA mg/dl	**24,6**	**21,1**
CELLULE SOMATICHE	**131.327**	**116.495**

CLINOPTILOLITE E BOVINE DA LATTE

I risultati interessanti sulla qualità del latte sono principalmente dovuti al miglior ambiente ruminale ed intestinale: la capacità adsorbente su vari prodotti tossici prodotti dalla digestione degli alimenti rende “migliore” l’ambiente dove lavorano i batteri ruminali ed intestinali.

La Clinoptilolite esercita un effetto “tampone” anche per l’alto pH (quasi 9)

CLINOPTILOLITE E BOVINE DA LATTE

Elimina (riduce fortemente) odore ammoniaca in allevamento e contribuisce ad un ambiente più salutare per animali e uomo.

Elevata capacità di assorbimento di alcune micotossine consente di ottenere forti riduzioni di assorbimento di queste pericolose sostanze.

Capacità “sequestrante”, in funzione del tipo di micotossina, va dal 45-50% fino al 90% (Università di Piacenza e Milano)

CLINOPTILOLITE E MICOTOSSINE

La capacità sequestrante della CLINOPTILOLITE per **Zearalenone** è stata dimostrata nel rumine artificiale (Prof.ssa Sciaraffia, Università di Milano) dove l'aggiunta di Clinoptilolite ha determinato una riduzione nel liquido ruminale del 50% di zearalenone a distanza di 6 ore dall'introduzione (25% dopo 8 ore).

CLINOPTILOLITE E MICOTOSSINE

capacità sequestrante della CLINOPTILOLITE per alcune micotossine:

Zearalenone: 50%

Tossina T2: 40%

Deossinivalenolo: 45%

Aflatossine: 90%

AFLATOSSINE NEI FORAGGI E NEL LATTE PREVENZIONE E RISCHI

Realizzato Ufficio Qualità - Gruppo Grifo Latte

AGGIUNGERE O MANTENERE DEI SEQUESTRANTI:

l'utilizzo dei sequestranti (**zeoliti**, sepioliti, bentoniti, carbone vegetale ecc.) è una misura preventiva da raccomandare senza però incorrere nell'errore di considerarla risolutiva.

CLINOPTILOLITE E BENESSERE ANIMALE

Possibilità di impiego nelle lettiere e/o cuccette:

Riduzione dell'ammoniaca nell'ambiente,
Eliminazione di insetti, formiche ecc…
Lettiera più asciutta e migliore come sanità
Miglior pulizia della mammella (indiretta),
Prevenzione acidosi (meno problemi podali…)

CLINOPTILOLITE E … altri aspetti

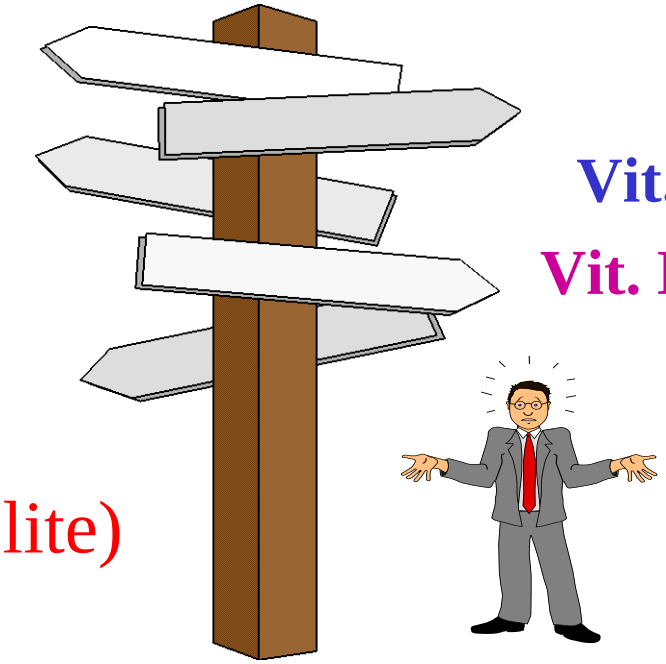
Migliora la consistenza delle feci (più sostanza secca e meno acqua) e riduce i problemi enterici (migliora la "sanità" dell'intestino per assorbimento prodotti tossici della digestione degli alimenti).

Minori rischi di acidosi e miglior ambiente ruminale

PRINCIPI NUTRITIVI CHE FACILITANO L'ADATTAMENTO

SOSTANZE MIRATE PER IL RIEQUILIBRIO DIGESTIVO

- Lieviti
- Vitamina PP
- Potassio
- 1,2 propandiolo
- Zeoliti (clinoptilolite)



SOSTANZE MIRATE PER LA RISPOSTA IMMUNITARIA

Vit. C

Vit. gruppo B

Vit. E (e selenio)

Zinco

Cromo

SOSTANZE PER RIEQUILIBRIO DIGESTIVO

CLINOPTILOLITE

- **Scambiatore ionico minerale**
- **riduce ammoniaca nel rumine**
- **rallenta transito intestinale**
- **migliora consistenza delle feci**

CLINOPTILOLITE E … FECI

(Tassinari e coll., Atti Buiatria, 2000)

		CLINOPTILOLITE	CONTROLLO
SOSTANZA SECCA	% SS	**19,05**	17,33
CELLULOSA GREGGIA	% SS	19,66	19,28
CENERI	% SS	**20,00**	21,19
AMIDO	% SS	**3,06**	3,33
NDF	% SS	48,98	51,23
ADF	% SS	30,77	32,35
ADL (LIGNINA)	% SS	12,30	10,28

CLINOPTILOLITE E … digeribilità

Rallenta transito intestinale e favorisce pertanto una miglior utilizzazione dei nutrienti (amido, minerali, ecc…).
Nel bovino da carne (e nei suini) si sono ottenute migliori performance di accrescimento proprio per la miglior utilizzazione della razione (migliora la conversione dell'alimento)

Clinoptilolite e bovini da carne

		CLINOFEED	CONTROLLO
Razione con insilati			
PESO INIZIO PROVA	kg	410	403
PESO FINE PROVA	kg	668	651
INCREMENTO TOTALE	kg	**258**	**248**
IMG	kg	1,32	1,27
Razione a secco			
PESO INIZIO PROVA	kg	443	458
PESO FINE PROVA	kg	724	727
INCREMENTO TOTALE	kg	**281**	**269**
IMG	kg	1,55	1,48

Clinoptilolite e bovini da carne

I risultati delle ricerche nei bovini da carne hanno evidenziato migliori performance di accrescimento e concentrazioni nel sangue più elevate di Calcio, Sodio, Potassio, Magnesio e Zinco, indipendentemente dalla razione utilizzata (a secco o con insilati) e minori di urea .
Questo dimostra la miglior utilizzazione dei minerali presenti nella dieta

Conclusioni

Quanti grammi al giorno sono necessari per le vacche da latte??
100-150 grammi/capo

In che percentuale si utilizza nei mangimi??
Autorizzata al 2% in tutti i mangimi

Nelle lettiere e cuccette??
Da 200 a 500 grammi/m^2