Mik production and components

Milk, kg	Fat	Protein	Lactose
	3.3	**3.1**	**4.9**
30	990	930	1470
40	1320	1240	1960
50	1650	1550	2450
60	1980	1860	2940

Carbohydrates

- Milk production is limited by glucose supply (Kronfeld, 1976);
- 72 g of glucose is necessary for each kg of milk (Kronfeld et al. 1968);
- For a production of 40 kg/d, 3 kg of glucose are necessary;

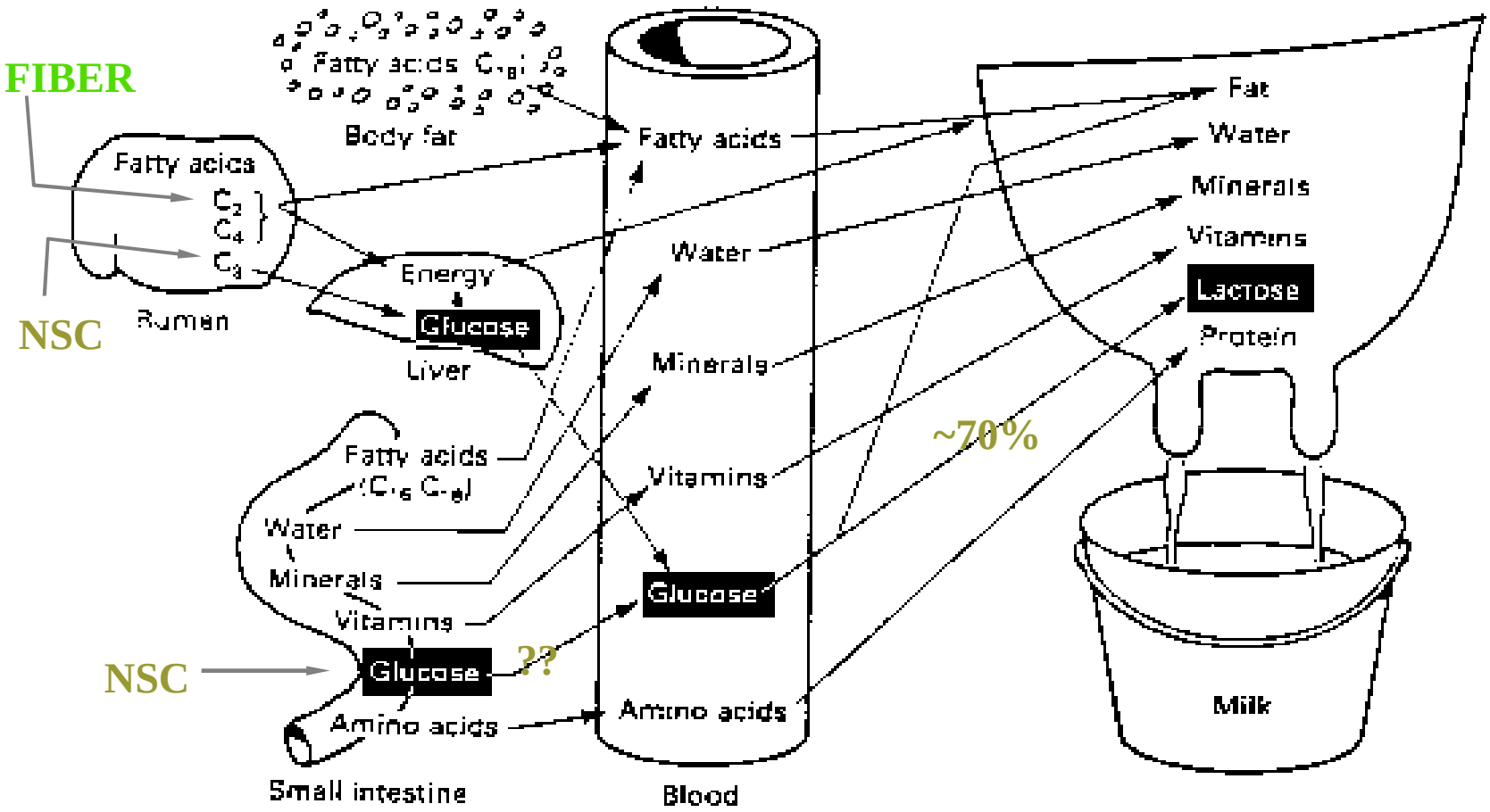
Carbohydrates

- Carbohydrates (CHO) rapresent 65-70% of the diet

  100-(Ash+CP+EE);

- Only non structural carbohydrates (NFC) are a suitable substrate to supply glucose

  100-(Ash+CP+EE+NDF);


FIBER
NSC
Fatty acids C16
Body fat
Fatty acids
C2
C4
C3
Rumen
Energy
Glucose
Liver
Fatty acids
(C16 C18)
Water
Minerals
Vitamins
Glucose
NSC
??
Amino acids
Small intestine
Blood
Water
Minerals
Vitamins
Glucose
Amino acids
~70%
Fat
Water
Minerals
Vitamins
Lactose
Protein
Milk

NFC Compositions

Starch 70-90%

Sugar

Pectins

Volatile Fatty acids (Silages)

Rumen degradable Starch

- Supply energy for microbial growth:

  1kg of fermented CHO $\rightarrow$ ~220 g microbial protein;

- This correspond to about il 5% of protein requirement for a cow producing 40kg/d;

- Within certain limits rumen degradable starch can stimulate DM Intake through a greater rumen bacterial growth;

- The increase of 1 kg deg. starch $\rightarrow$ +0.48kg of milk (Nocek and Tamminga, 1991)

Rumen degradable Starch : limits

- Large amounts of deg. Starch will produce an excessive quantity of VFA (propionate and lactic):
  - low ruminal pH;
  - reduction of ruminal activity;
  - reduction of fiber digestibility;
  - reduction of intake, milk fat and in same cases reduction of milk production

Rumen degradable starch

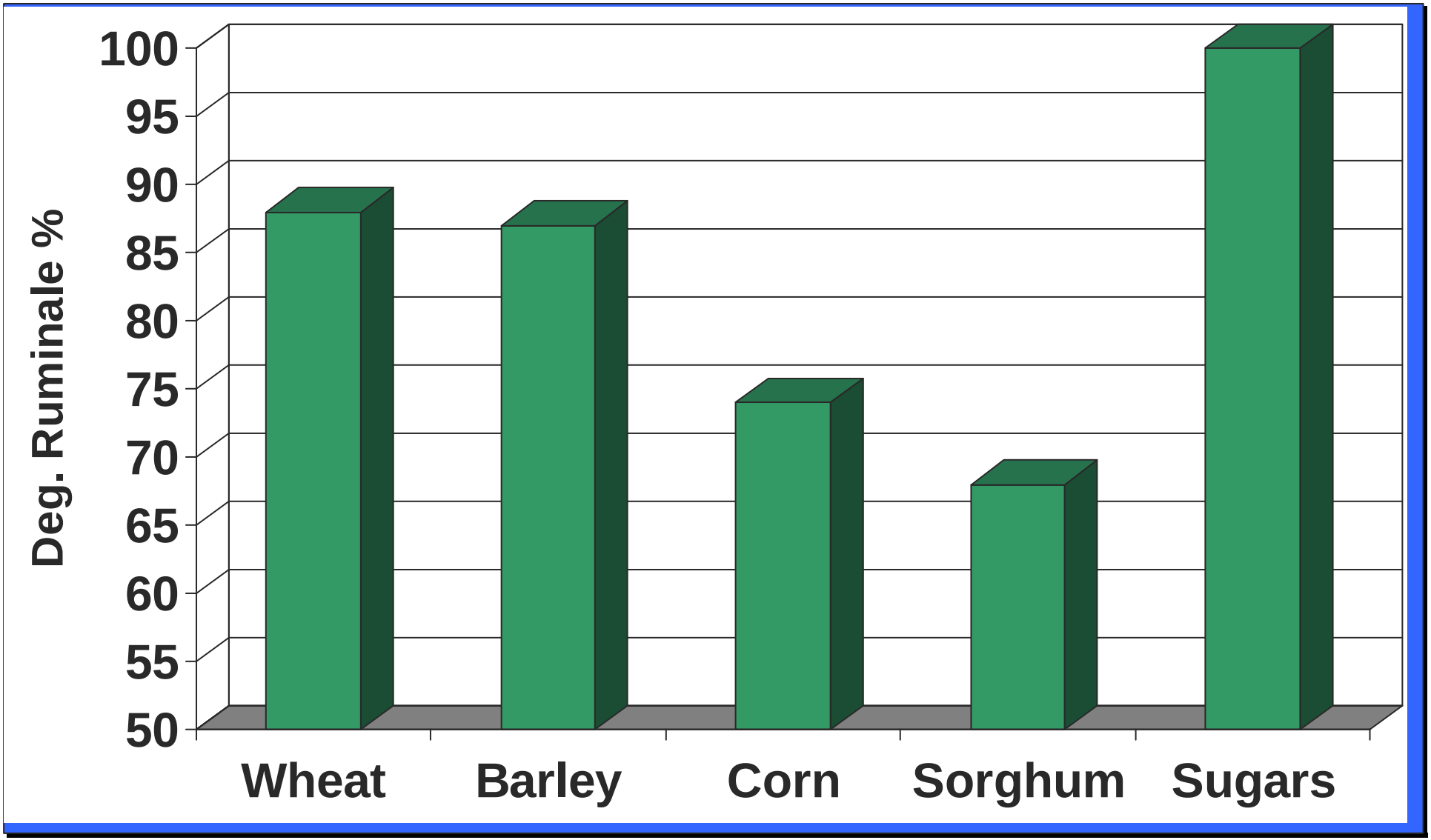
varies:

-Type of grain (corn, barley, wheat,…)

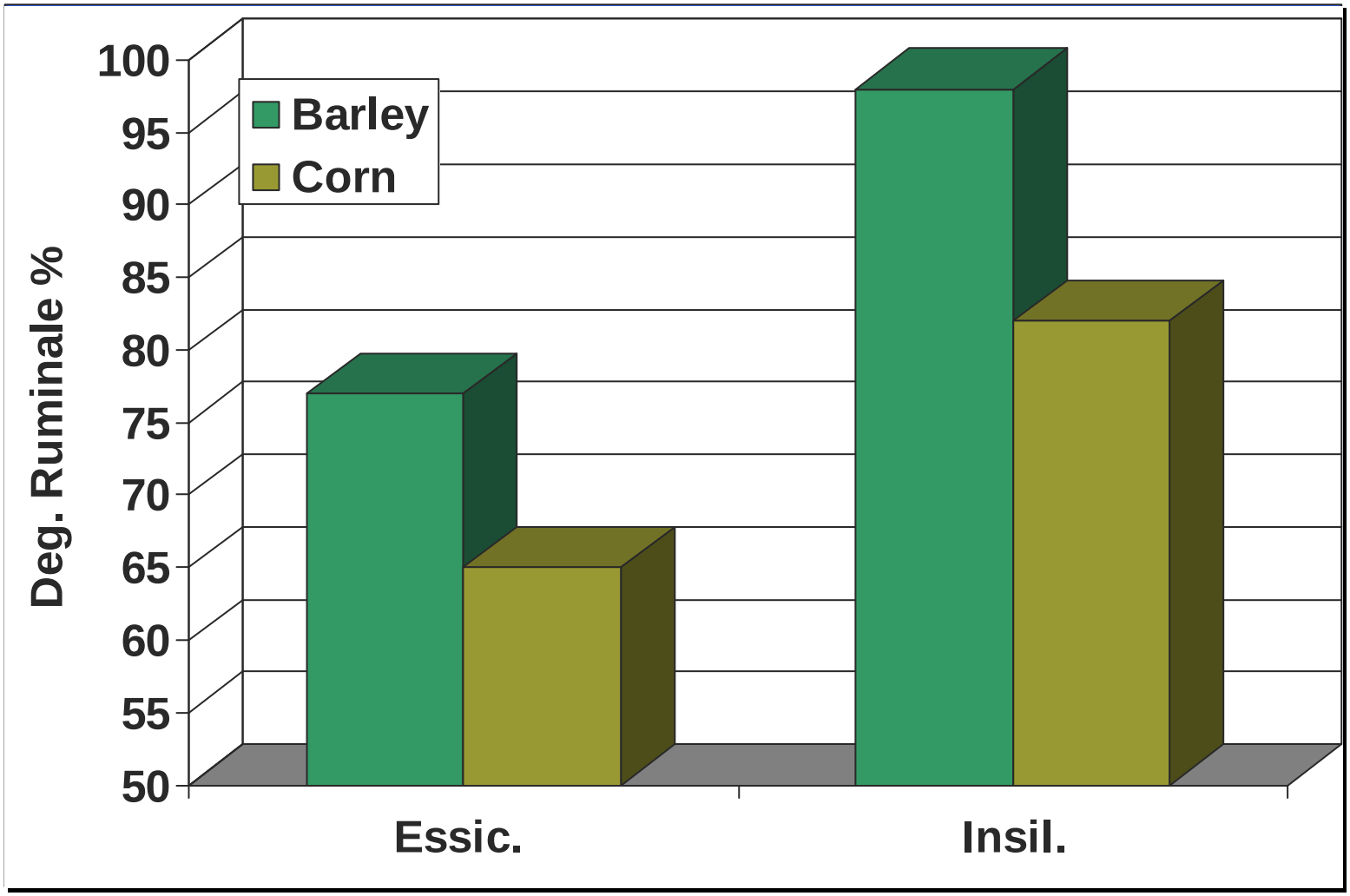
-Particle size

-Conservation method (dry or silage)

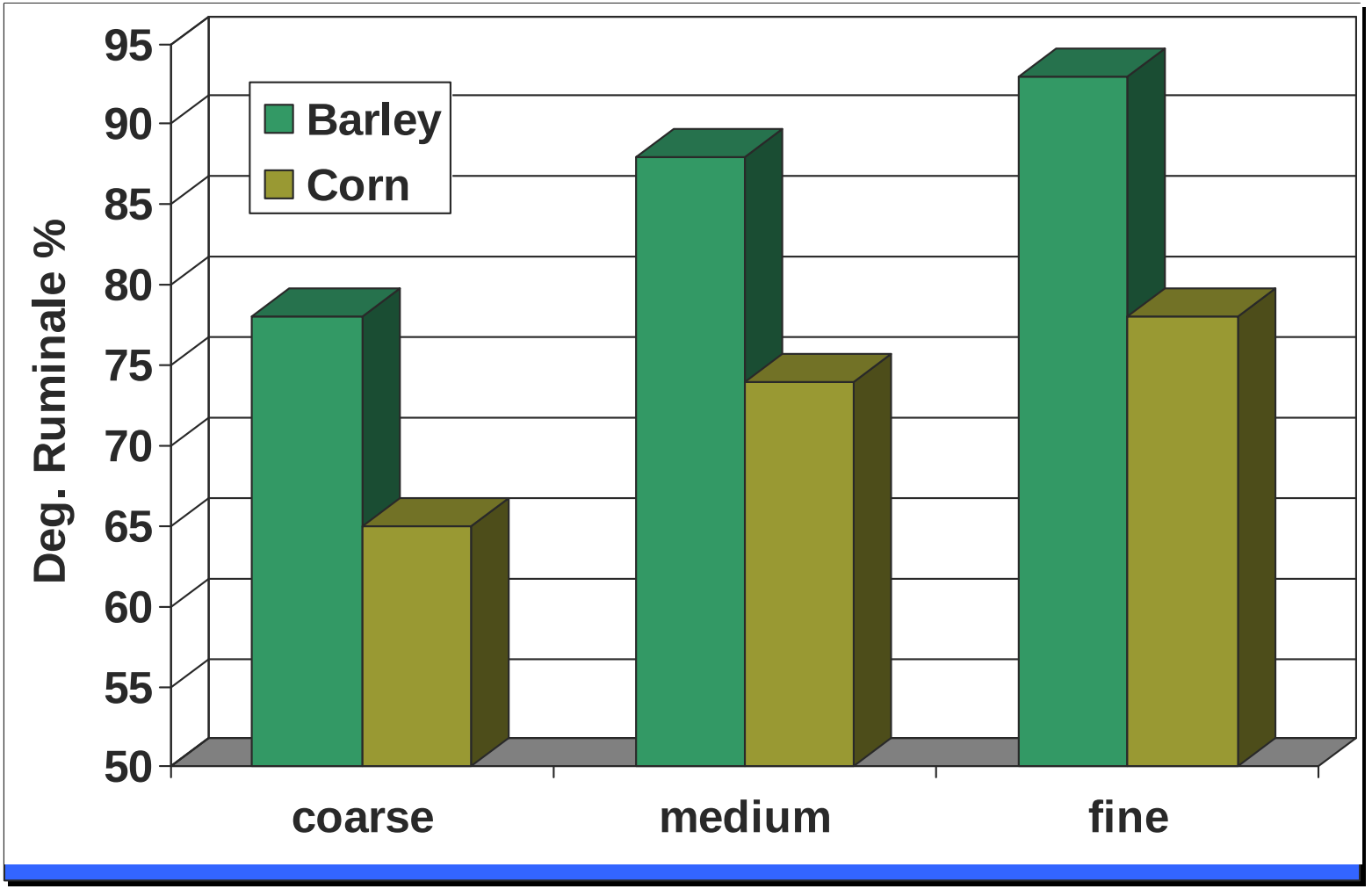
Rumen degradable starch : Sources



Rumen degradable starch :
Conservation method



Rumen degradable starch : Particle size



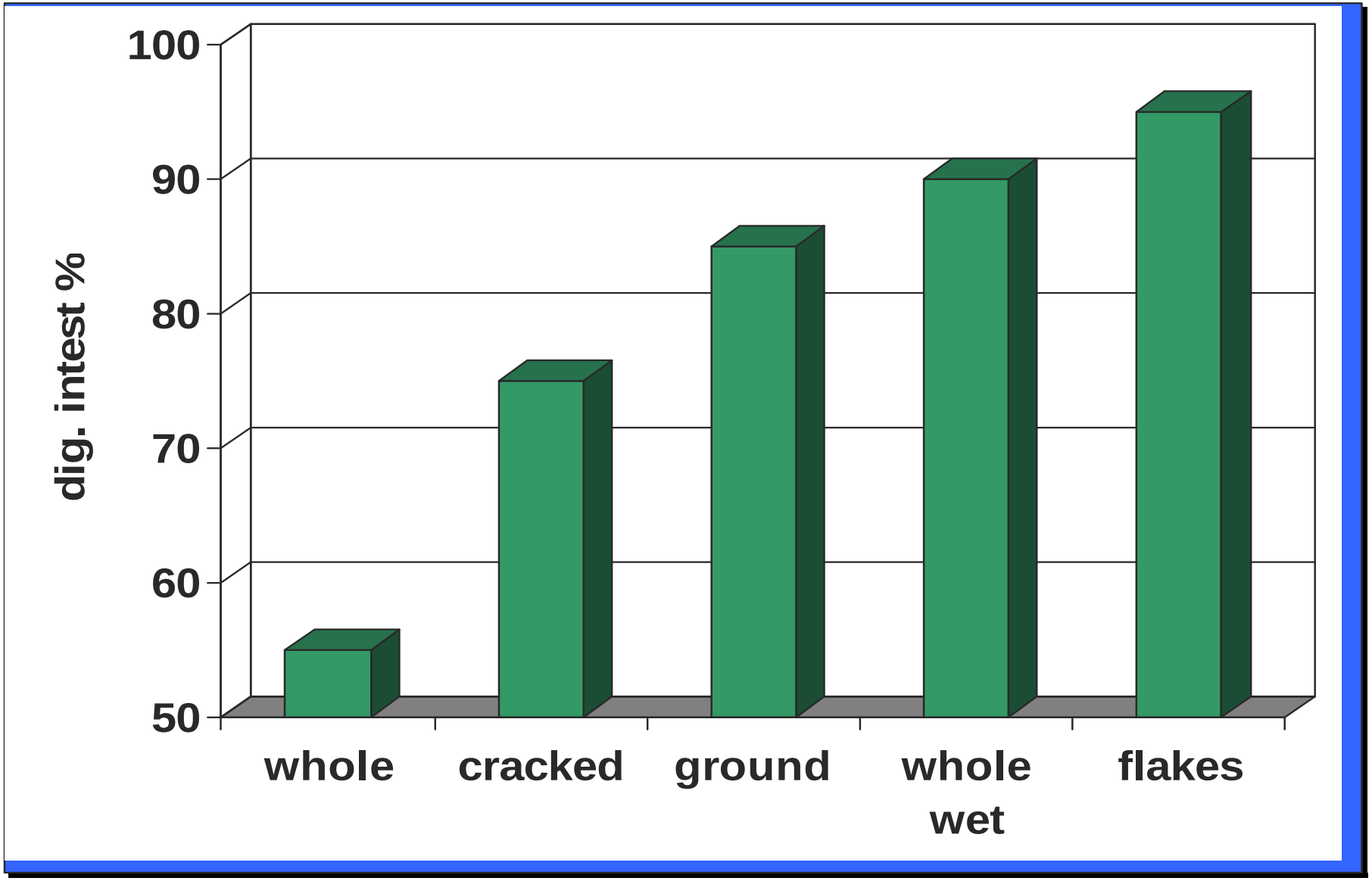
Intestinal dig. Starch (IDS)

- Theoretically is the most efficient method to supply glucose to the udder;
- increasing 1 kg of IDS → +2.28 kg of milk (Nocek and Tamminga, 1991);
- Allows to reduce the rumen load of fermentable starch;

Limits to IDS

- It seems like there are limit on the amount of IDS;
- Older literature indicate a maximum of 1.5 kg/d;
- Most recent research have obtained 3.0kg/d of IDS;
- Starch not digested in the intestine → feces. It is a net loss!!!;
- Particles greater then 1 mm can limit intestinal digestion (Owens et al, 1986)

IDS of corn starch



Separation of Corn Kernels and Large Kernel Fragments Using Sieving

Losses of starch

Sieve feces to see it!!

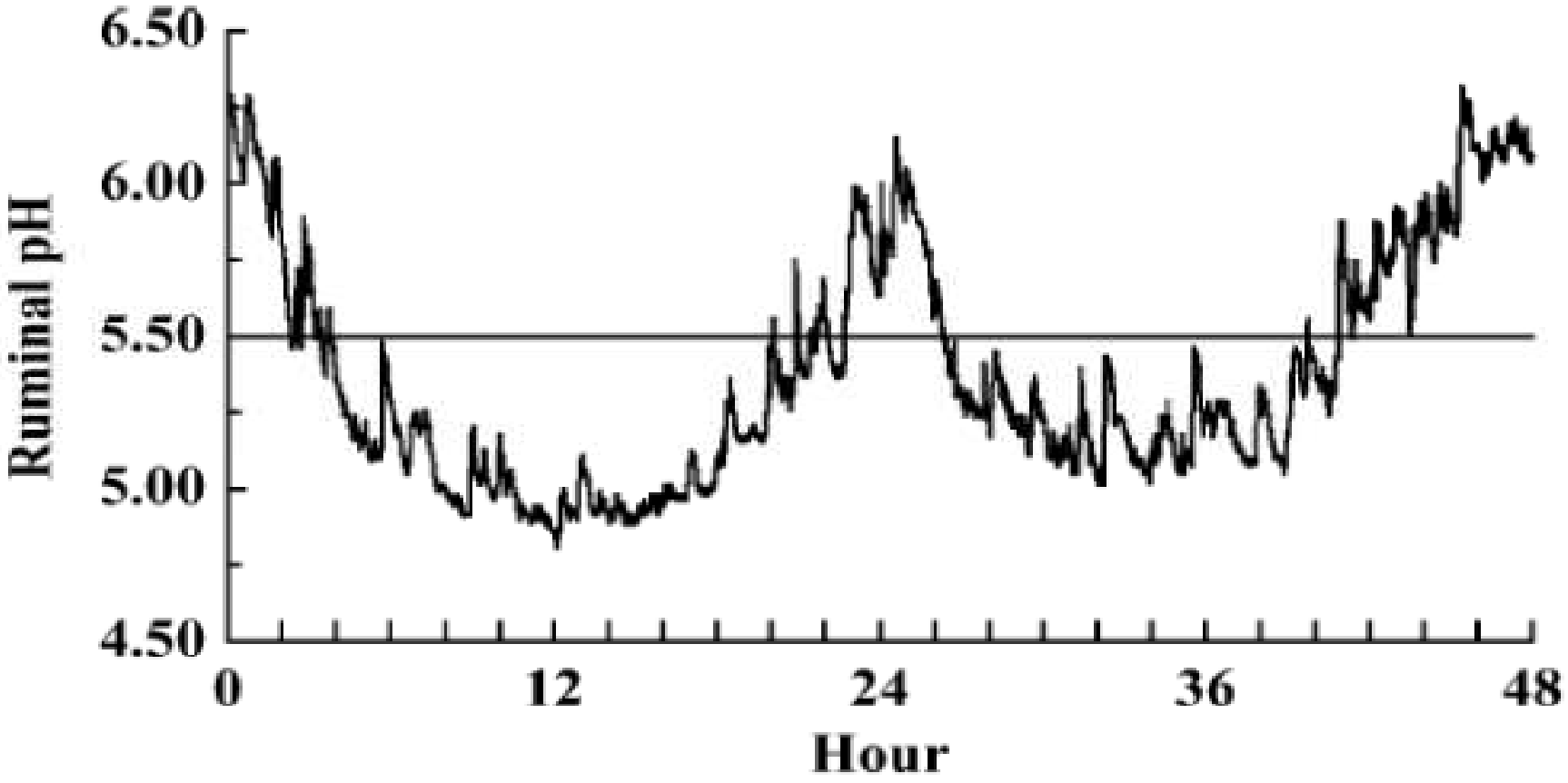
Subclinical ruminal acidosis (SARA)

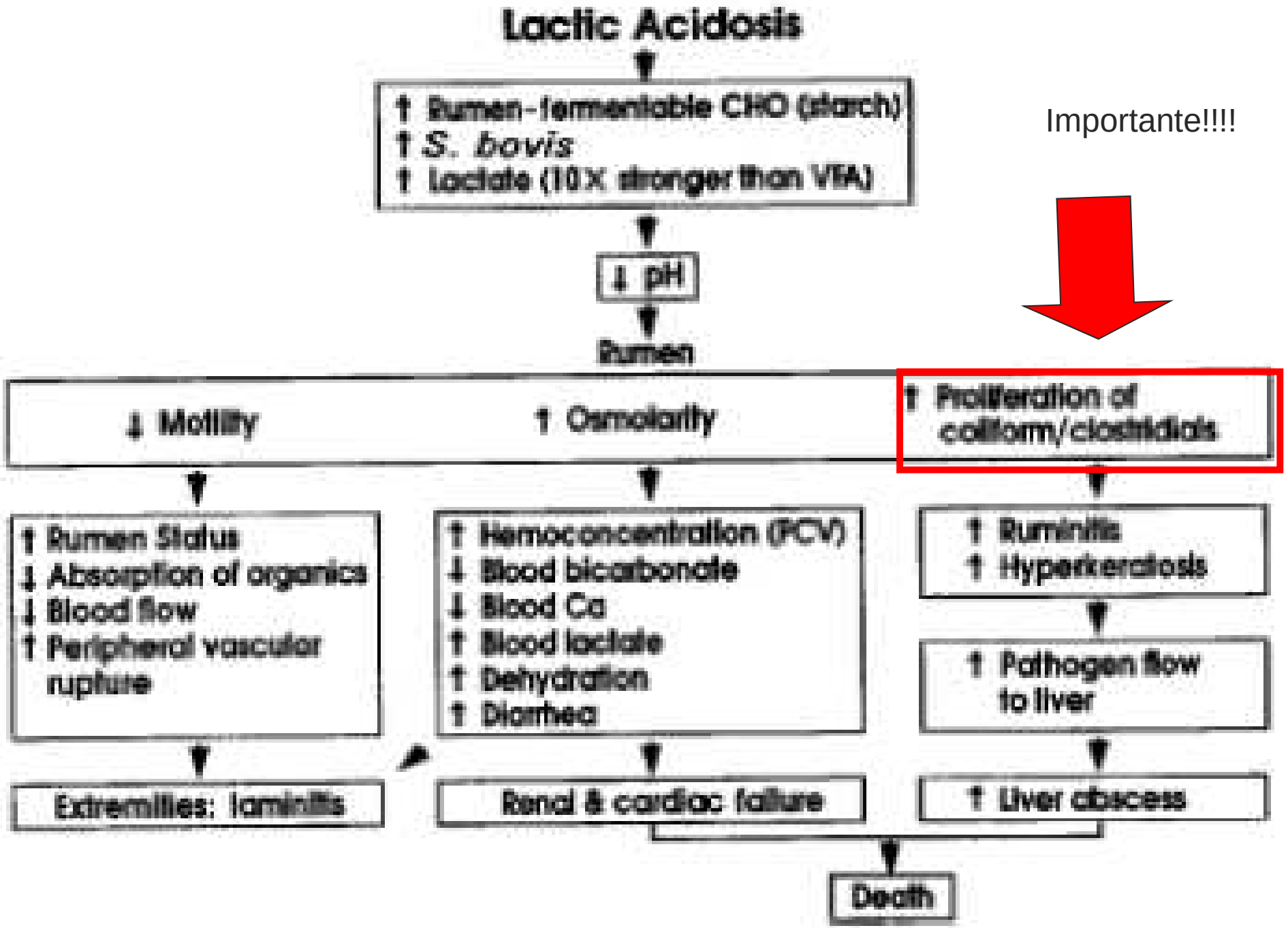
Ruminal fluid:

Normal	pH>5.8
Warning	pH 5.5-5.8
Acidosis	pH <5.5

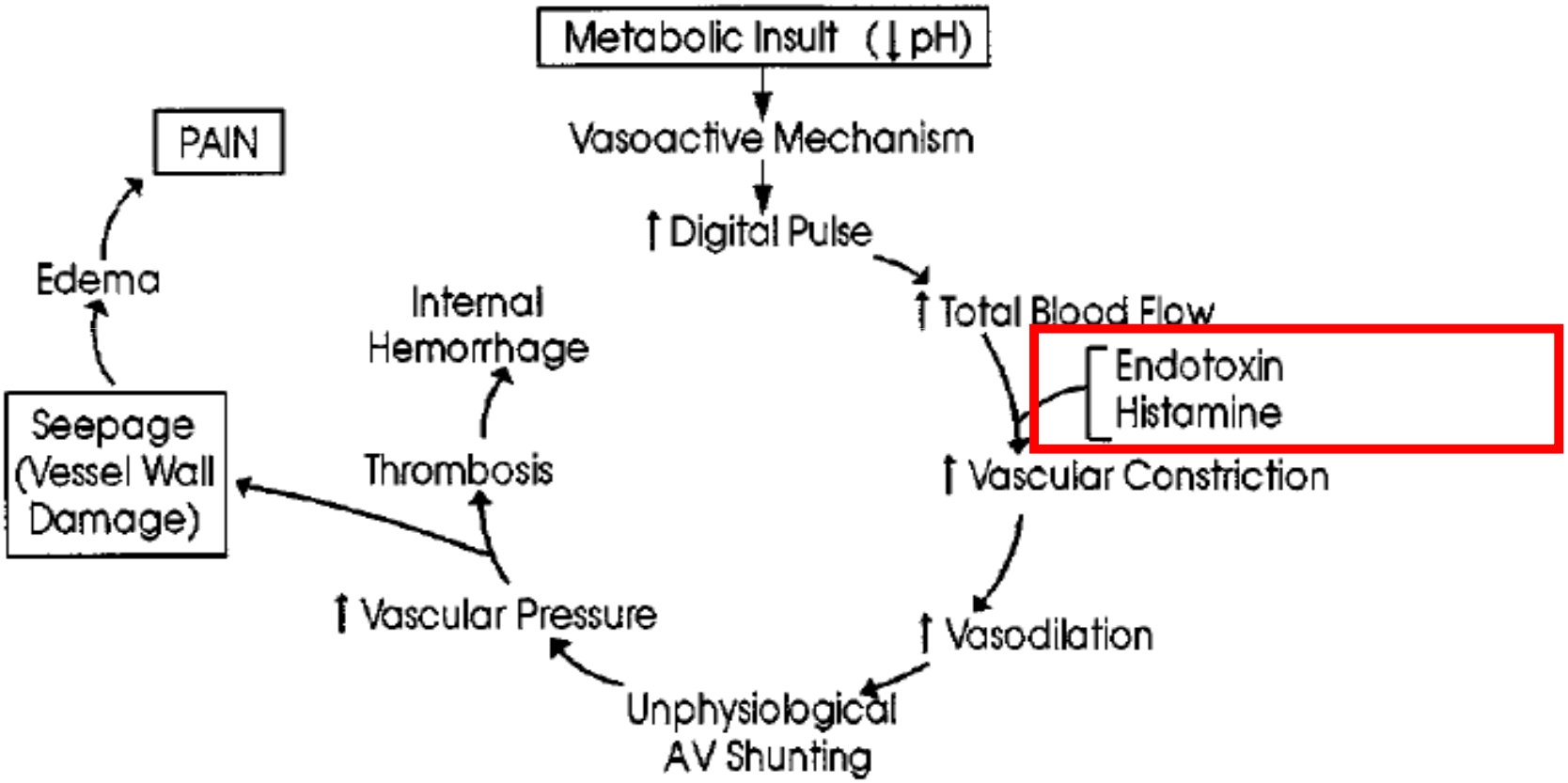
- The measurament should be performed on a large number of animals and less than 25% should have ruminal pH lower 5.5.
- In practice the measuraments should be performed on at least 12 animals:
  - **Normal** max 1 animal pH <5.5
  - **Warning** 2-4 animals pH <5.5
  - **SARA** >4 animali pH <5.5 (Oetzel, 2001)

Acidosis




Lactic Acidosis
↑ Rumen-fermentable CHO (starch)
↑ S. bovis
↑ Lactate (10X stronger than VFA)
↓ pH
Rumen
↓ Motility
↑ Osmolarity
↑ Proliferation of coliform/clostridials
↑ Rumen Stasis
↓ Absorption of organics
↓ Blood flow
↑ Peripheral vascular rupture
↑ Hemoconcentration (PCV)
↓ Blood bicarbonate
↓ Blood Ca
↑ Blood lactate
↑ Dehydration
↑ Diarrhea
↑ Ruminitis
↑ Hyperkeratosis
↑ Pathogen flow to liver
Extremities: laminitis
Renal & cardiac failure
↑ Liver abscess
Death

Importante!!!!

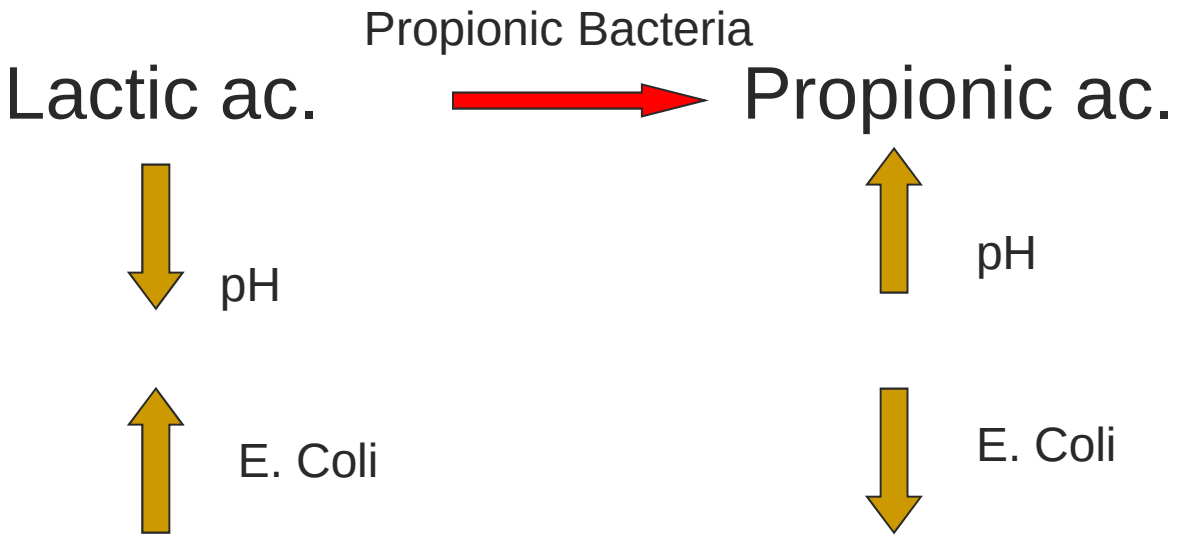

Metabolic Insult (↓ pH)
Vasoactive Mechanism
↑ Digital Pulse
↑ Total Blood Flow
Endotoxin
Histamine
↑ Vascular Constriction
↑ Vasodilation
Unphysiological AV Shunting
↑ Vascular Pressure
Thrombosis
Internal Hemorrhage
Seepage (Vessel Wall Damage)
Edema
PAIN

Subclinical ruminal acidosis sub-clinica (SARA)

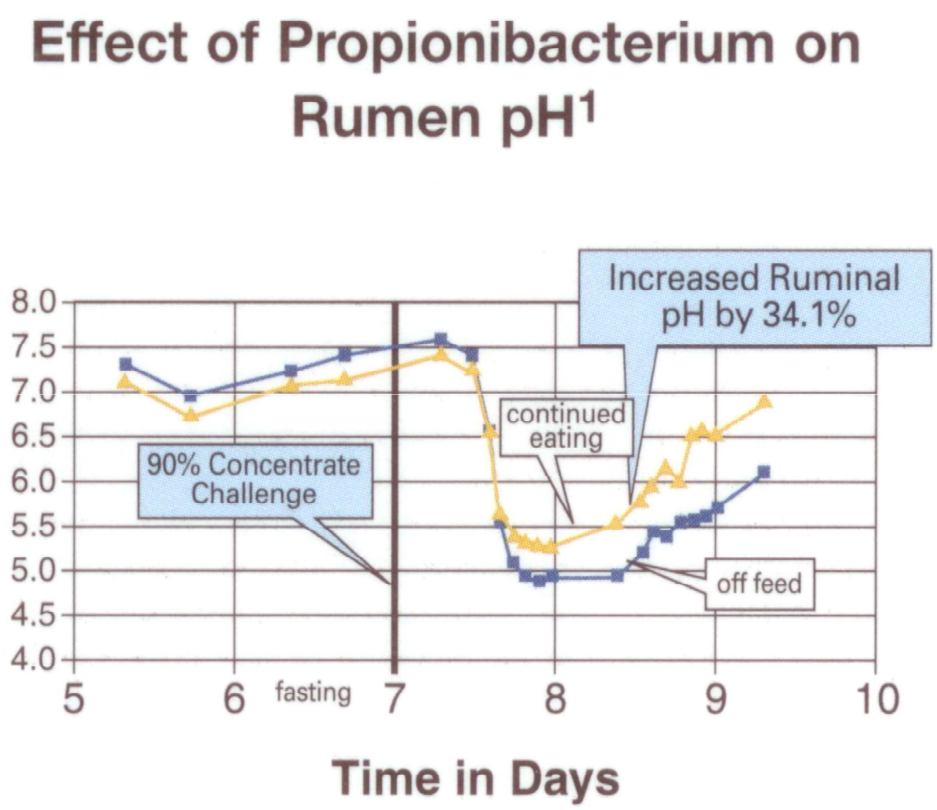
- 6 dairy farms in Veneto (Morgante e coll., 2004)
  - 1 Normal
  - 2 Warning
  - 3 SARA

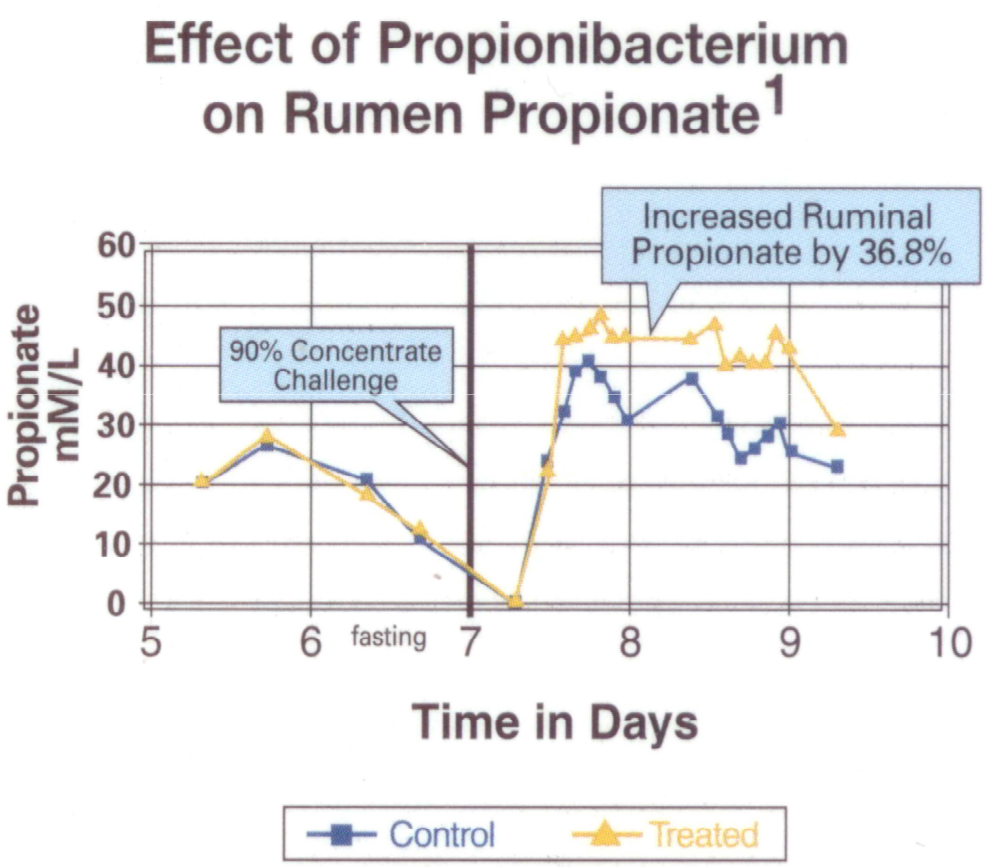
- SARA is present in our farms more than we previously thought.
- The continuous increase in milk productivity can only increase the problem. There is a need for a greater awareness relative to this problem..

Rapid metabolization of lactic acid



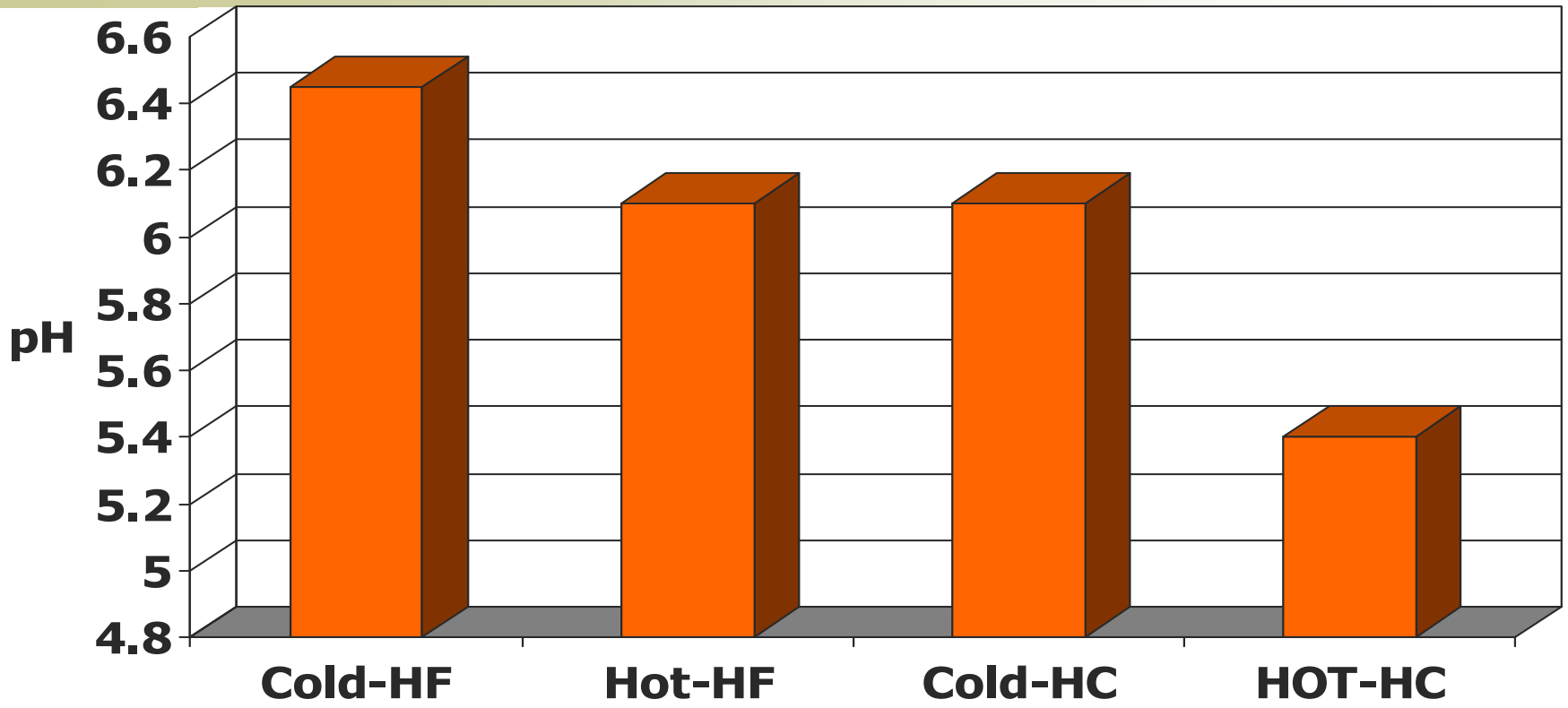
Modifying rumen bacteria population





Use of Propionibacteria for Cattle, F.N. Owens, T.Rehberger, T. Parrott, Oklahoma State University

Effect of Temp°and diet on ruminal pH



- Cold = 19 °C; Hot= 29 °C
- HF = High forage; HC = High concentrates

(Mishra e coll, 1970)

Effect of corn to barley ratio on milk production

Corn:Barley	100:0	75:25	50:50	25:75	0:100	Effect
DMI, kg/d	22.8	22.1	21.3	19.5	19.6	L
Starch digested:						
Rumen, % intake	41.6	60.6	60.9	74.4	74.4	L
Post rumen, % intake	49.0	32.8	33.0	21.0	21.8	L
Post rumen, kg/d	3.6	2.3	2.3	1.4	1.4	L
Whole tract, % intake	90.8	93.5	93.8	95.4	96.2	L
NDF digested, % intake	51.6	50.5	45.8	46.5	46.5	L
Rumen pH	5.91	5.82	5.85	5.82	5.79	L
Ac:prop	2.47	2.00	1.90	1.76	1.80	L
Milk prod., kg/d	26.9	27.8	26.6	25.2	22.6	L
Fat, %	3.58	3.37	3.50	3.41	3.91	NS
Fat , kg/d	0.97	0.94	0.92	0.85	0.86	L

Overton et al, 1995

Guidelines for high producing cows

- Starch should represent 23-28 of the diet.
- Low fiber diets (28-30% NDF) should use starch sources less fermentable in the rumen (corn rather than barley or high moisture corn)
- The goal is to maximise rumen degradable starch to stimulate rumen microbial growth without causing ruminal acidosis.