Actisaf®
Beef Presenter

yeastsolutions.co.uk

Phileo
LESAFFRE ANIMAL CARE

What is Actisaf®?

- Actisaf® is a **specific strain of live yeast** of the species Saccharomyces cerevisiae
- Yeast are **single cell organisms** classified as fungi
- Yeast ferments carbohydrates, **respiring oxygen** and producing carbon dioxide

Key factors for a live yeast to be effective:

- **Strain** - Actisaf is a specific strain selected for performance as a feed additive
- **Stability** - Actisaf has a unique drying process that gives excellent stability
- **Dose** - Yeast must be adminstered at the correct dose to get the optimum response

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About Phileo Lesaffre

- **Actisaf®** is produced by Phileo Lesaffre Animal Care, part of Lesaffre, the **world's largest manufacturer of yeast**

- Around **40% of the world's yeast** is made by Lesaffre!

- **Actisaf®** is produced by a **unique and patented fermentation process** in the production plant in Lille

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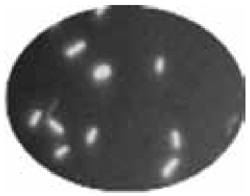
Digestion in the rumen

The rumen is a **large fermentation chamber packed full of microbes**, which:

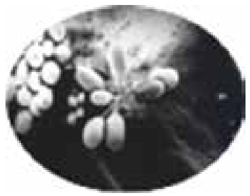
- Digest feed to **make energy and protein available** to the animal
- Require a **low oxygen environment**, and **pH between 6.0-7.0**, to optimise feed digestion

Bacteria
~300 species
10^{10} to 10^{11} cells/ml



Methanogenic Archaea
~6 species
10^{6} to 10^{8} cells/ml

Ciliate Protozoa
~40 species
$<10^{5}$ cells/ml



Anaerobic Fungi
~30 species
$<10^{5}$ cells/ml

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Digestion in the rumen - "feed the bugs first"

Cattle consume feed

Microbes digest feed

Microbes grow

Microbes produce energy in the form of Volatile Fatty Acids (VFA)

Some microbes are washed out of the rumen and provide the majority of the cow's protein requirements

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Maximising returns

- Plan to achieve **maximum weight gain per kg of feed**
- Highest feed efficiency is realised in **young animals** and declines with age
- Focus on **protein first to growing cattle** to grow frame and avoid small, over-fat animals
- Focus on **energy first in finishing diets** to hit target slaughter weight and conformation

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Common diet targets for growing & finishing cattle

Growing cattle diet targets (Continuous frame growth)	
DMI	2.3% BW
DLWG (KG)	0.7-1.3kg
DM	30-60%
CP	15-16%
Mj ME	10.5-11.4
NDF	>40%
Fat	<3%
Starch & Sugars	>20%
Calcium	0.80%

Finishing cattle diet targets (short sharp period of max DLWG)	
DMI	2% BW (Approx)
DLWG	>1.4kg
DM	30-60%
CP	12-15%
Mj ME	>12.2
NDF	>25% NDF
Structural Fibre	6-8%
Fat	<6%
Starch & Sugars	>33%

(EBLEX, 2013)

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Water - the forgotten nutrient

- Cattle require between **5-7 litres of water per kg dry matter** consumed
- The water content of feed is very variable
- Cattle will drink together so **water supply must cope with peak demand**
- All stock must have an **uninterrupted supply of fresh, clean and easily accessible water** at all times
- Water troughs should ideally be inspected daily and, if contaminated with straw or faeces, they should be **cleaned out**

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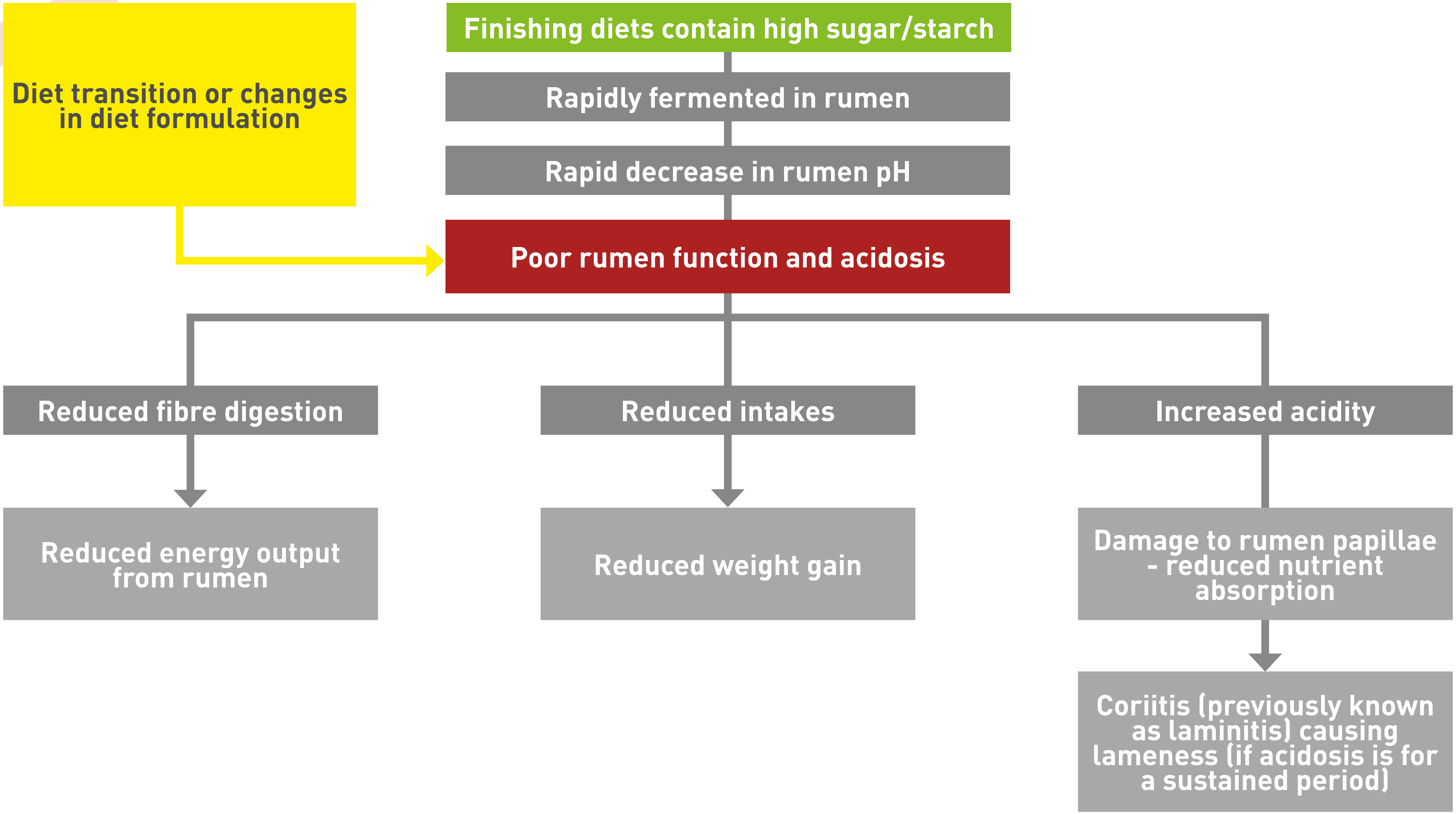
Challenges to rumen function



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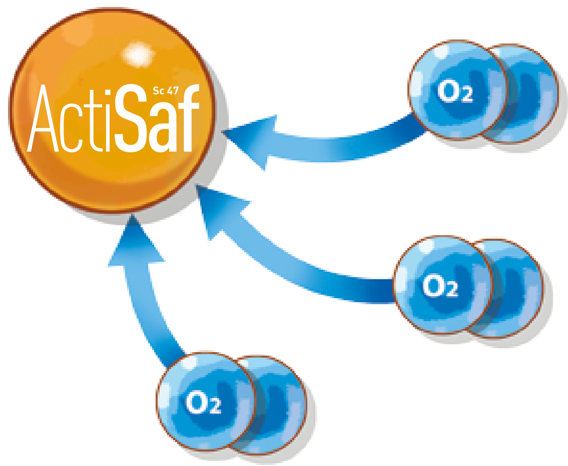
How does Actisaf® work in the rumen?

- The rumen is continually challenged by **oxygen, which is toxic to rumen bacteria**

- **Actisaf® uses up oxygen**, resulting in the **growth of fibre-digesting bacteria and lactate-utilising bacteria**, increasing feed digestion and **stabilising rumen pH, which prevents acidosis** from developing

- **Actisaf®** allows the microbes to **convert lactate to propionate**, a volatile fatty acid (VFA) that optimises growth rates, feed efficiency and lean meat production

- **Five grams of Actisaf® has been proven to have the equivalent buffering effect of 150 grams of sodium bicarbonate**, thereby stabilising rumen pH



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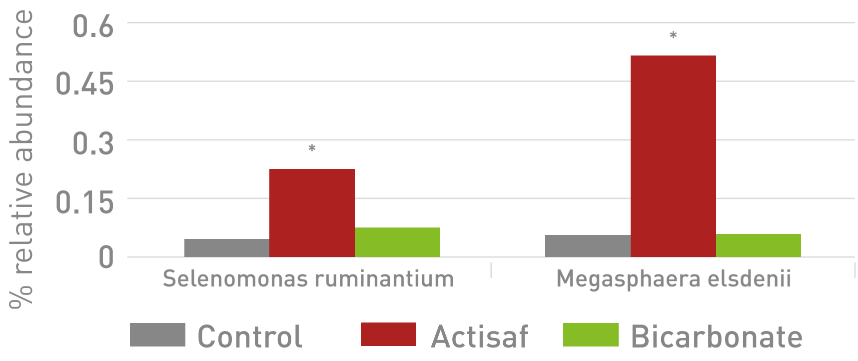
Actisaf® vs Bicarbonate
Fermentation parameters & fibre degradation

How does Actisaf live yeast differ from sodium bicarbonate in stabilising ruminal pH in high yielding dairy cows?

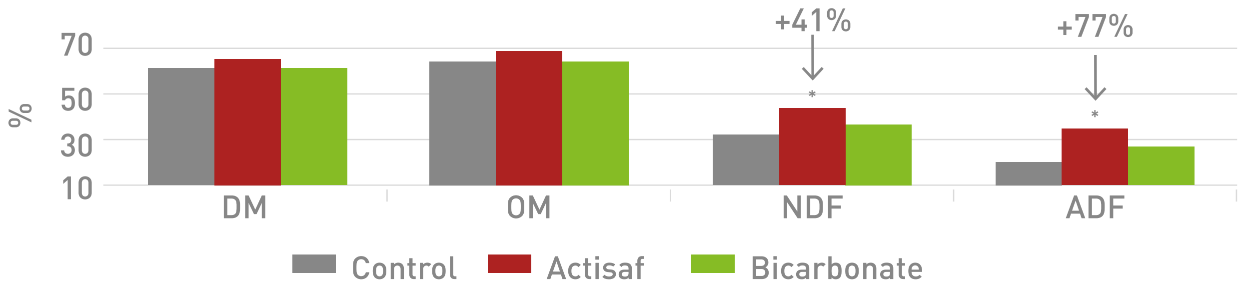
(mM)	Control	Actisaf*	Bicarbonate
Total VFA	85.3[a]	99.4[b]	95.3[b]
Acetate	53.2[a]	59.1[b]	60.8[b]
Propionate	18.0[a]	**25.8[a]**	20.0[a]
Butyrate	10.6	10.2	10.1
Lactate	16.5[b]	**5.4[a]**	12.2[b]

*Note Actisaf delivers an increase in proprionate (a glucose precursor essential for lean meat production) over control and over bicarbonate, and a reduction in lactate

Impact of Actisaf on lactate-utilising organisms



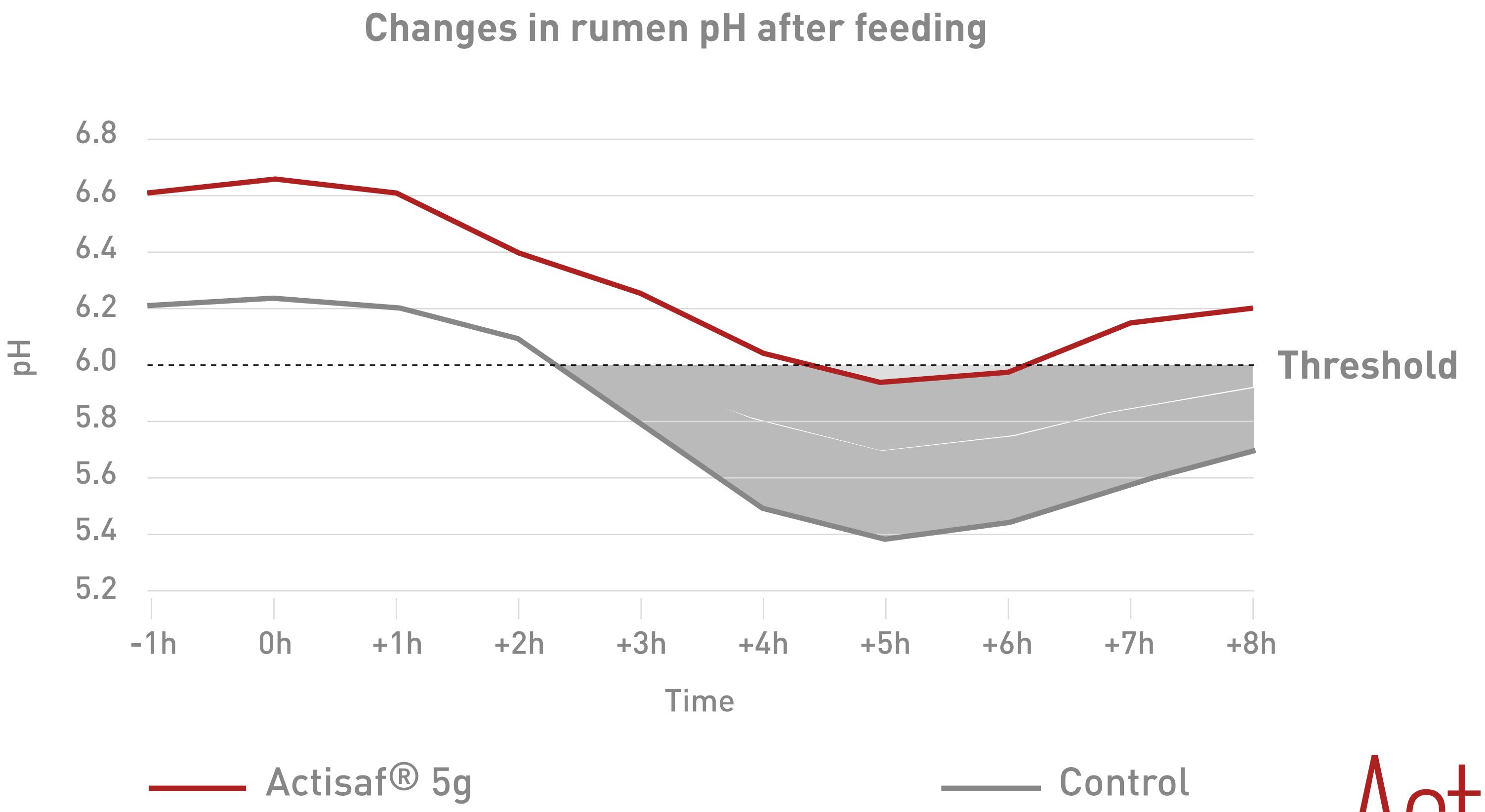
Digestibility trial



Journal of Dairy Science (Marden et al., 2008).

Actisaf stabilises rumen pH

Rumen pH drops after feeding. **Actisaf® stabilises rumen pH, thereby avoiding the negative impact of low pH on the rumen microbes** and associated negative health consequences:

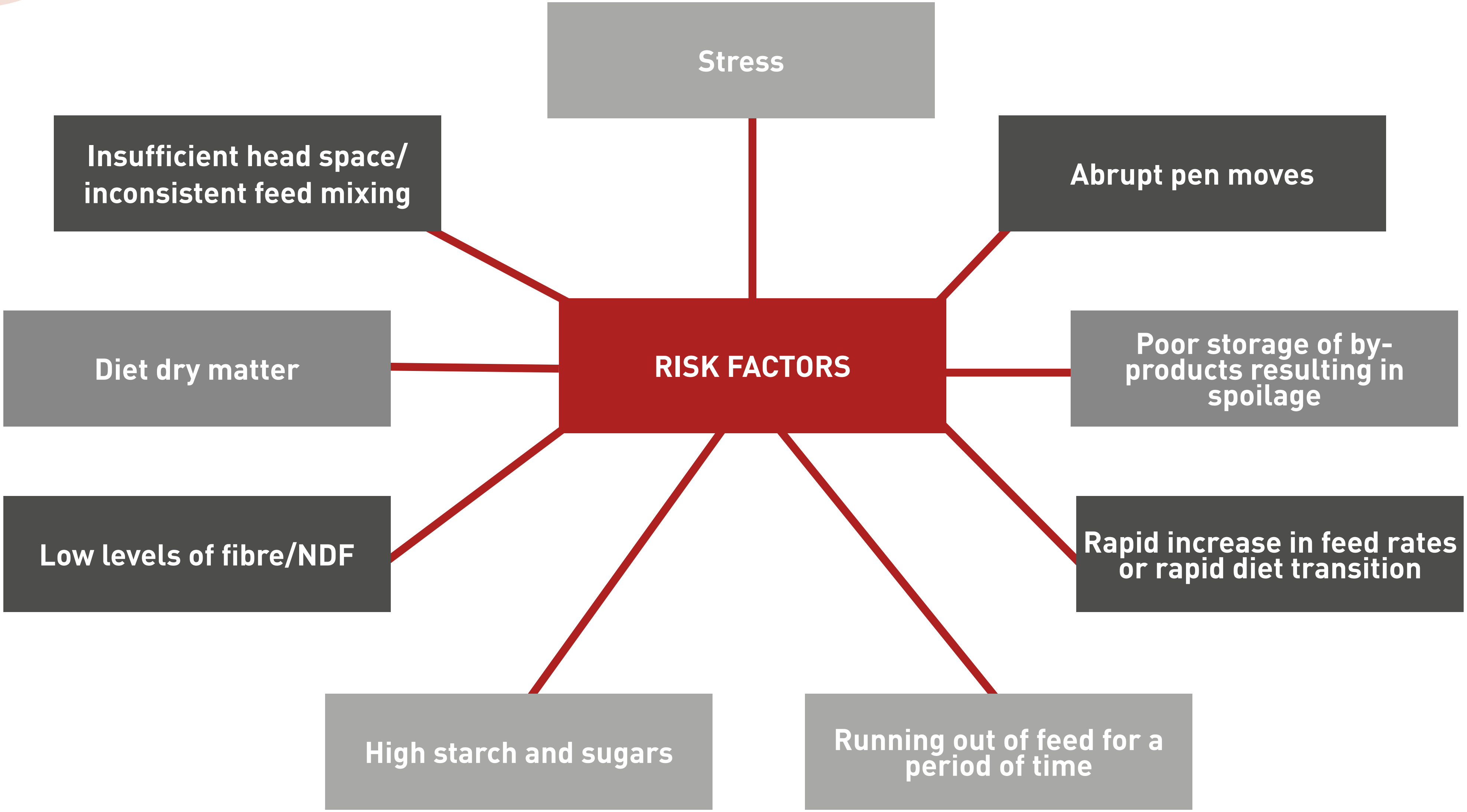


What are the benefits of Actisaf®?

Actisaf® creates a more favourable environment for the rumen microbes resulting in:

- Improved digestibility and feed utilisation
- More stable rumen pH
- Increased DM intakes
- Improved carcass classification
- Less ‘stalling’ of cattle on diet change
- Up to 9% improvement in DLWG
- Up to 4.3% improvement in FCE

Risk factors for poor rumen function

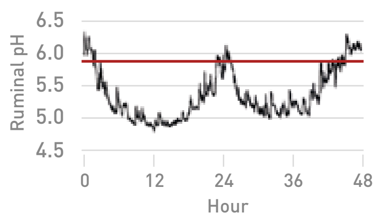


pH fluctuation after feeding ad lib diet

Ruminal pH over a 48 hour period of a steer adapted to a 92.5% concentrate diet based on dry-rolled corn fed once daily at 0 and 24 hours. Ruminal pH was monitored with a submersible pH electrode suspended through the plug of the ruminal cannula and was recorded every minute:

E18 Nagaraja and Titgemeyer

(Cooper et al., 1998)

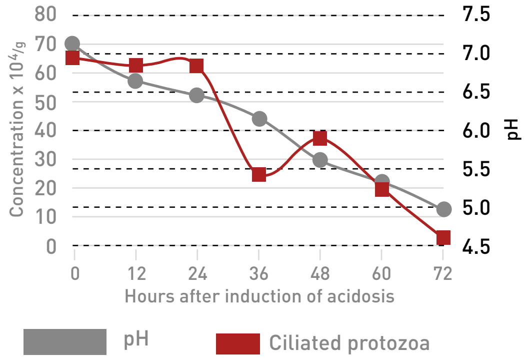


Affect of low rumen pH on rumen microbes?

Ruminal ciliated protozoal population and ruminal pH in cattle with experimentally induced acute acidosis and subacute acidosis:

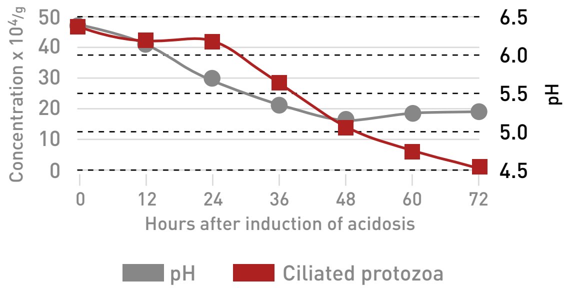
Ruminal acidosis

(Nagaraja and Towne, 1990)



Ruminal acidosis

(Goad et al., 1998)



Reduced ciliated protozoa is indicative of reduced fibre digestion

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Useful research references...

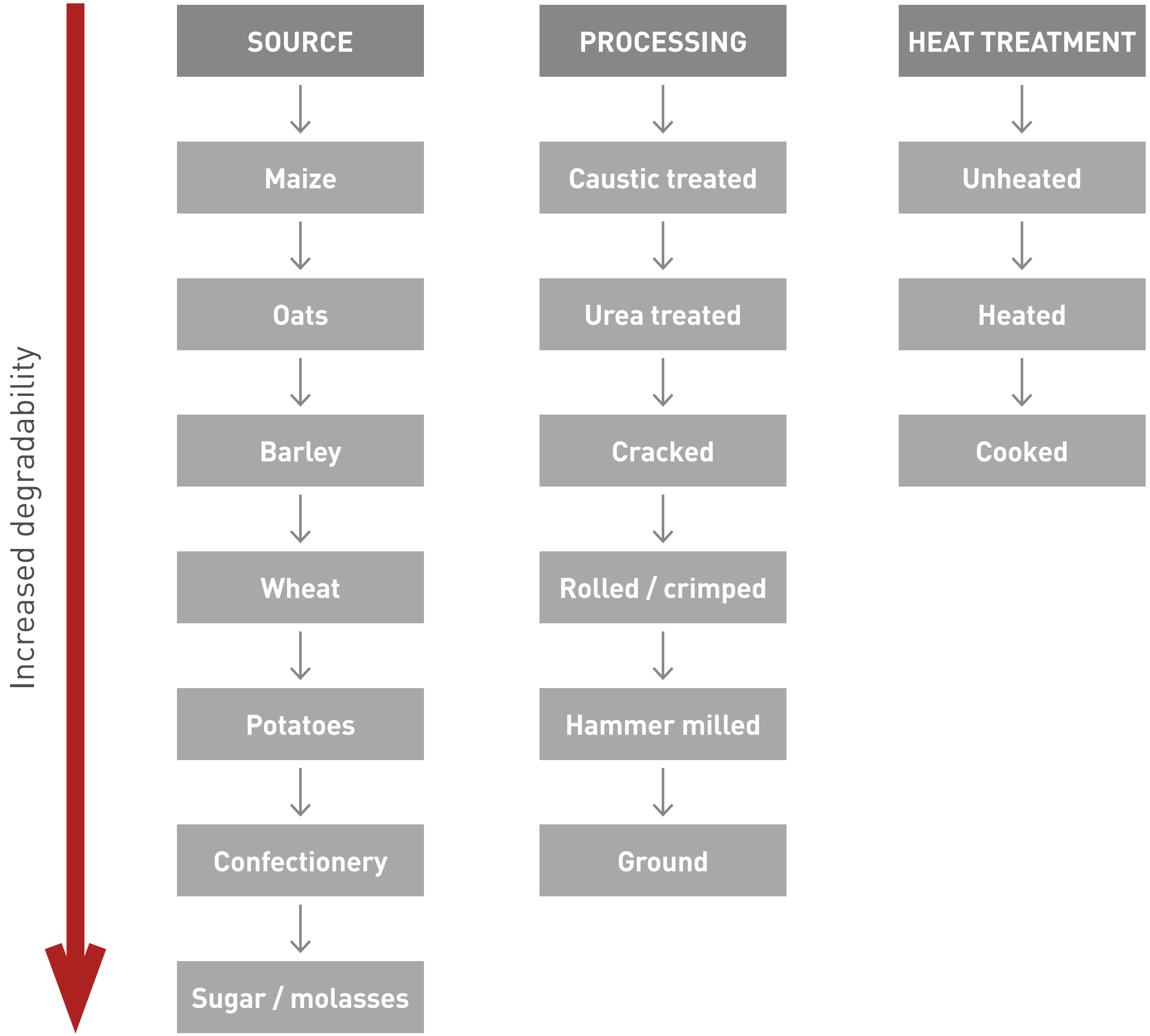
Schwaiger et al (2014). This research showed that cattle exposed for a short time (8 days) to concentrates before an induced acidosis challenge recovered more slowly than cattle exposed for longer (34 days) (recovery from acidosis at -369min/day rather than -588min/day, P = 0.019). This indicates that greater time allows better adaption of the rumen, resulting in more stable rumen pH.

Holtshausen et al (2013). 16 animals were transitioned from a high-forage diet to a finishing diet in three steps. Mean daily ruminal pH declined (from pH 6.26 to pH 5.81) and mean duration of time below pH 5.5 increased from 2.58hr/day to 8.31hr/day by the end of step 3. In addition DMI declined and meal size and duration were reduced. The study concluded that a more gradual change to a finishing ration could reduce the incidence and severity of acidosis.

Castillo-Lopez et al (2014). This study showed that animals in the last 50 days of the finishing period had lower mean rumen pH (6.0) and more time/day when rumen pH was below 5.5 (194 mins/day). This increase in ruminal acidosis risk was attributed to days on feed and dry matter intake in the finishing period.

Cereal choice and level of processing

Factors that **increase the rumen degradability of starchy feeds:**



(Morris & Chalcombe., 2014)

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Warning signs

- Unexplained diarrhoea
- Loose dung
- Variable dung consistency (can indicate diet sorting)
- Soft, grey or foamy dung
- Mucin/fibrin casts in the dung
- Gas bubbles in dung
- Reduced feed intake
- Weight loss
- Lethargy
- Rapid breathing
- Poor ruminantion rates/cud chewing
- Poor feed digestion - undigested fibre/grains in dung
- Tail swishing in absence of flies

Acidosis damages rumen pappillae

Pappillae are finger-like projections in the rumen that are vital for nutrient absorption

Healthy pappillae

Damaged pappillae

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Summary

- Focus - **maximum weight gain per kg of feed**, which is reliant on balanced nutrients, good management and **optimum rumen function**

- High starch and sugar diets and diet transition can cause **rumen acidosis**, limiting performance

- **Actisaf creates a more favourable environment for rumen microbes**, improving feed conversion efficiency, intake, daily liveweight gain and carcass classification

- **Feeding Actisaf delivers an average return on investment of €39 (£36) per animal**

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Unit 1, Doagh Business Park,
11 Kilbride Road, Doagh, BT39 0QA

Office: +44 (0)28 93 34 39 00
www.yeastsolutions.co.uk

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Supplementary information

Challenges to rumen function

- Ruminal acidosis is a digestive disorder that occurs in all ruminants
- When cattle consume feed, microbes ferment feed that feed and produce mainly acid (volatile fatty acids as well as some other short chain fatty acids CO2, methane, etc.)
- These VFAs are the dominant energy source for ruminants
- Problems occur when too much acid is produced and cattle are not able to neutralise the acid which lowers the rumen pH (acidity)
- When pH gets too low we see:
    - Reduced fibre digesting microbes
    - Increased numbers of microbes that ferment feeds into a stong acid called lactic acid (moving into acute acidosis)
    - Production of toxins from dying microbes which can induce inflammation (endotoxins, ethanol, amines & histamines)
    - Damage to the epithelium/lining of the stomach reducing the amount of nutrient that can be absorbed and potentially allowing microbes & toxins to enter the blood stream
    - Liver damage
    - Laminitis
- Any change in diet requires the rumen microbes to adapt
- This generally takes around 3 weeks
- However, if too much starch/sugar in the form of cereals or byproducts are fed often the bugs cannot adapt quickly enough
    - Leading to a a drop in the pH (acidity of the rumen)
    - Leading to a condition known as subclinical ruminal acidosis
    - As the pH drops fibre digesting microbes cannot function
    - When the pH drops even further the bugs that normally produce propionate (key source of glucose for lean meat gain) switch to producing lactic acid (10x more acidic) making the problem, even worse leading to a condition known as acidosis

Energy - brief explanation

- Carbohydrates, such as fibre, starch and sugars, are mainly broken down into volatile fatty acids (VFAs) by the rumen microbes - mainly acetate, propionate and butyrate - with some being digested further down the digestive tract to glucose. Dietary fat is also essential and supplies a small amount of the animal's energy requirements. Excess amounts of certain kinds of fat in the diet can inhibit the rumen microbes, and ruminants can only attain a small proportion of their dietary requirements from dietary fat sources
- Volatile Fatty Acids (VFAs) are absorbed across the rumen wall to provide energy for the animal
- Problems arise when VFAs accumulate faster than the animal can absorb them
- Leading to a condition known as sub-acute ruminal acidosis

Protein - brief explanation

- Protein comes in two forms depending on whether it can be degraded by the microflora in the rumen or not
- Degradable protein is broken down by the microflora into amino acids, or synthesised from non-protein nitrogen if adequate energy (carbon) is present
- These amino acids are used by the microflora themselves for growth and reproduction
- Microbes are constantly washed out of the rumen, where they provide amino acids which are digested and absorbed in the stomach and small intestine. Amino acids are the building blocks of protein and muscle as well as other vital body functions
- Rumen undegradable protein is not broken down directly and it provides amino acids directly to the small intestines
- Microbial protein should be maximised first, as it supplies most of the animal's protein requirements. It is important to ensure the right conditions are present in the rumen - rumen degradable energy in balance with rumen degradable protein - and correct rumen pH, a low oxygen rumen environment and adequate water intakes

Ruminal acidosis in beef cattle

Comparison of acute and subacute acidosis in beef cattle[1]		
	Acidosis	
Item	Acute[2]	Subacute[2]
Clinical signs	Present	Absent
Mortality	Yes	No
Ruminal Changes		
Fermentation products		
Ruminal pH	<5.0	5.0 to 5.5
Total organic acids	Increased	Increased
Lactic acid	High (50 to 120 m*M*)	Normal (0 to 5 m*M*)
VFA	Below normal (<100 m*M*)	High (150 to 225 m*M*)
Microbes		
Gram-negative bacteria	Decreased	No change
Gram-positive bacteria	Increased	No change
Streptococcus bovis	Increased initially	No change
Lactobacillus spp.	Increased	Increased
Lactic acid-producers	Increased	Increased
Lactic acid-utilizers	Decreased	Increased
Ciliated protozoa	Absent or decreased	Absent or decreased

Item	Acute[2]	Subacute[2]
Microbial "toxic" products		
Ethanol	Increased	ND[4]
Amines	Increased	ND
Endotoxins	Increased	Increased
Blood changes		
pH	Decreased (<7.350)	Normal to slightly decreased
Lactic acid	Increased, particularly D(-)	Normal
Bicarbonate	Marked reduction (<20 mEq/L)	Normal to transient reduction
Base status	Base deficit	Base excess
Packed cell volume	Increased (>40%)	Normal (30 to 35%)
Endotoxins	Yes	Yes
Inflammatory mediators	Yes	Yes
Sequelae		
Rumenitis	Yes	Yes
Laminitis	Yes	Yes
Polioencephalomalacia	Yes	Yes
Liver abscesses	Yes	Yes

[1]Data from Nagaraja et al. (1998)
[2]Changes in response variables are in relation to forage-adapted animal
[3]Changes in response variables are in relation to grain-adapted animal
[4]ND = not determined

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The Role of Actisaf®