Driving Down Shrink

Dr. Elizabeth Parker BVSc PhD

Dr. Tony Parker PhD

MEAT & LIVESTOCK AUSTRALIA

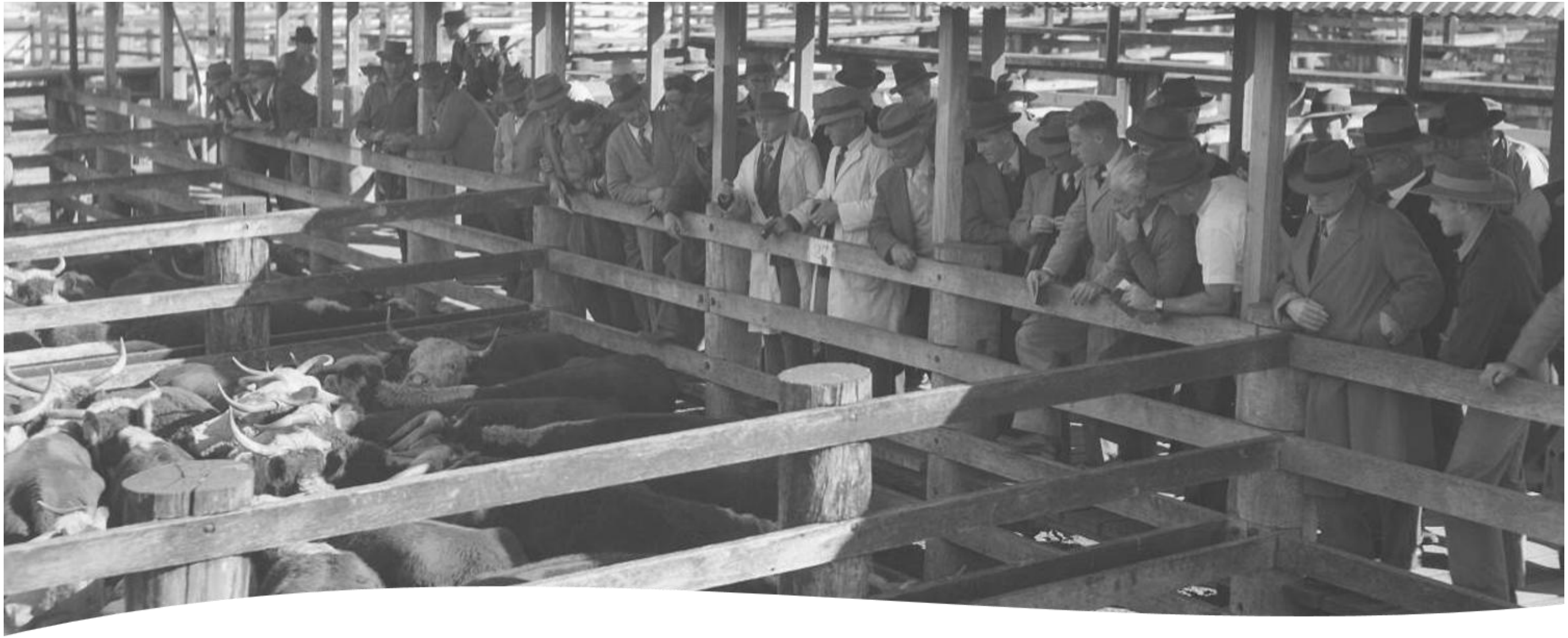
Industry Challenge

Weight loss in the supply chain

- Wellbeing,
- Body weight
- Average daily gain
- Carcass weight.
- Profitability,

MEAT & LIVESTOCK AUSTRALIA

Historical preparation of cattle



Cannon Hill Saleyards, Brisbane 1940 (SLQ)

Water Access in 1980 at saleyards

Wythes et al. (1980)

Water access before sale

Increased body and carcass weight

Why deprive cattle of feed and water during preparation?

- Decrease faecal contamination of the hide during transport
- Decrease microbial/pathogen contamination of the carcass
- Decreased slipping and falls on trailer by cattle

Where is the silver bullet for cattle body weight loss?

Treatment with vitamins A, D and E did not reduce weight loss in transported cattle

TF JUBB*, DS PINCH[†] and SR PETTY*

The Effect of Acepromazine Maleate[1] on Feeder Steers in Transit and Feedlot

by M. A. MacDonald*

The effects of fasting, electrolyte supplementation and electrical stimulation on carcass yield and meat quality in bulls

S. D. M. Jones, A. L. Schaefer, and A. K. W. Tong

Agriculture Canada, Research Station, Lacombe, Alberta, Canada T0C 1S0. *Contribution No. 716, received 10 June 1992, accepted 28 Aug. 1992.*

Physiological and metabolic effects of prophylactic treatment with the osmolytes glycerol and betaine on *Bos indicus* steers during long duration transportation[1]

A. J. Parker,[2] G. P. Dobson, and L. A. Fitzpatrick[3]

Effect of Shipping and Chromium Supplementation on Performance, Immune Response, and Disease Resistance of Steers[1,2]

E. B. Kegley[3], J. W. Spears[3,4], and T. T. Brown, Jr.[5]

Department of Animal Science and Interdepartmental Nutrition Program, North Carolina State University, Raleigh 27695-7621

Treating *Bos indicus* bulls with rumen transfaunation after 24 hours of transportation does not replete muscle glycogen

C. L. O. Leo-Penu[A,B], L. A. Fitzpatrick[B], H. N. Zerby[B,C] and A. J. Parker[B,D]

Was the answer to minimizing shrink under our nose?

Research Aim

- Identify drivers of weight loss and develop a predictive model

MEAT & LIVESTOCK AUSTRALIA

Why use a systematic review and meta-analysis?

Source: https://www.cqu.edu.au/library/browse-guides-and-videos/evidence-based-practice

Methods

- Systematic review
- Find published research that meets specific selection criteria

- Meta-analysis
- Analysis of data from studies that meet the selection criteria - not just one research project

Systematic review

- **Title**: transport* OR transit OR fasting OR fast OR "water deprivation" OR shipment OR "feed deprivation" OR curfew
- AND
- **Title**: cow* OR cattle OR beef OR dairy OR calf OR calves OR steer OR heifer OR bull OR carcass
- AND
- **Topic**: liveweight OR weight OR age OR BCS OR "body condition score" OR genotype OR "bos taurus" OR "bos indicus" OR "cross bre*"

Criteria for study selection

Inclusion and exclusion criteria for selection of studies to include in the meta-analysis	
Inclusion criteria	- Cattle over 100 Kg (ruminants) - Cattle deprived of feed and water while undergoing road transport (treatment) - Cattle deprived of feed and water without transport (control).
Exclusion criteria	- Cattle undergoing sea or rail transport - No body weight at the start of fasting - No body weight at the end of fasting) - No measures of variance for body weight. - Studies in which the cattle had access to feed and water during transportation. - Studies in which cattle had access to feed and water during rest stops.

Study selection

- Title and abstract screening of 585 peer-reviewed papers
- Full text screening of 210 papers
- Data extraction from 26 studies

Variables analysed for effects on body weight

Moderator	Description
Genetic type	*Bos indicus* (BI), *Bos taurus* (BT)*, Bos javanicus* (JV)*, and* crossbred (BI x BT)
Region	Region of origin
Sex	Bull, steer, female or mixed
Feed	The type of feed in the week prior to feed and water deprivation - total mixed ration, hay, forage
Treatment	Transport or not transported
Start weight	Body weight in Kg immediately prior to feed and water deprivation
Time	The amount of time the animal was deprived of feed and water

Results

26 studies

78 treatment groups

1,896 head of cattle

Results

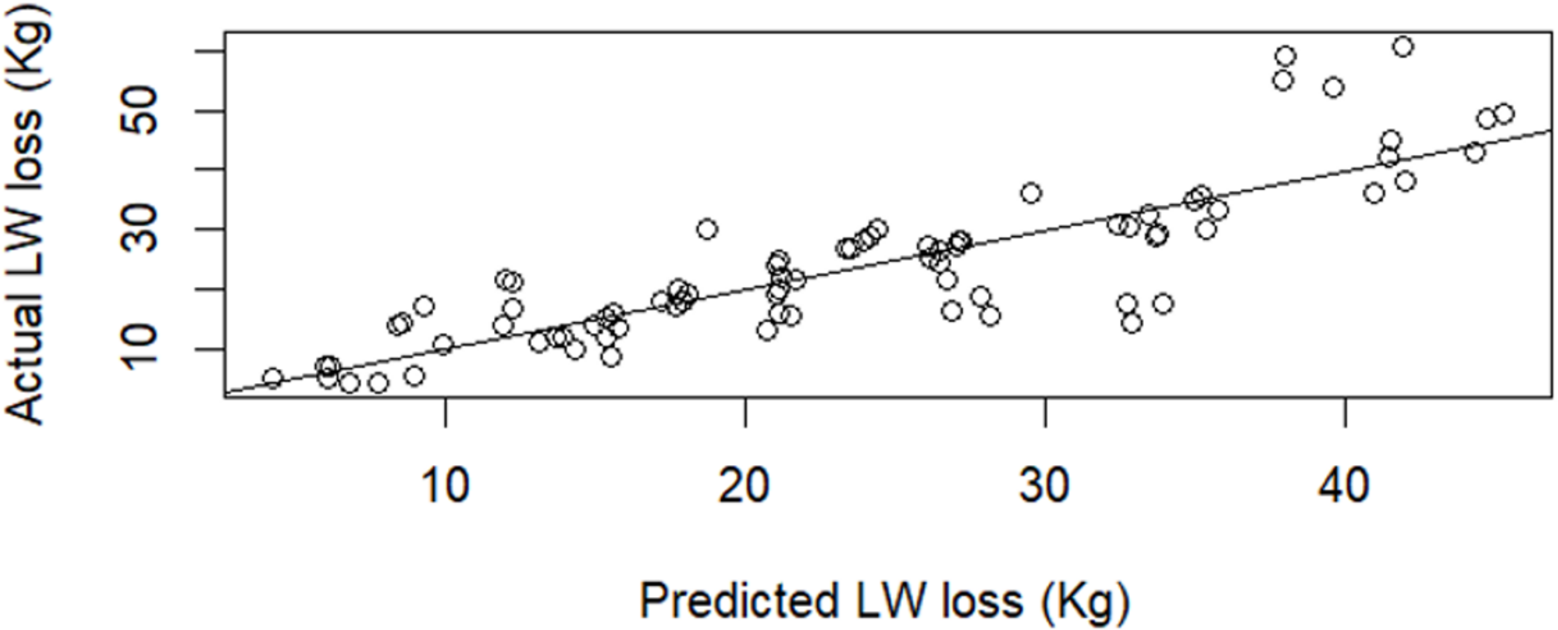
- Starting body weight and time of feed and water deprivation were the only significant modifiers of the amount of liveweight loss ($P < 0.001$)
- Transport was not a modifier of the effect of feed and water deprivation on weight loss

Results for univariable analysis

Results of a univariable analysis to estimate the effect of moderators on body weight loss

Moderator	P-value
Time	<0.0001
Start weight	<0.0001
Transport	0.3744
Genetic type	0.3417
Region	0.4501
Sex	0.6069
Feed type	0.8101

Predictive model



MEAT & LIVESTOCK AUSTRALIA

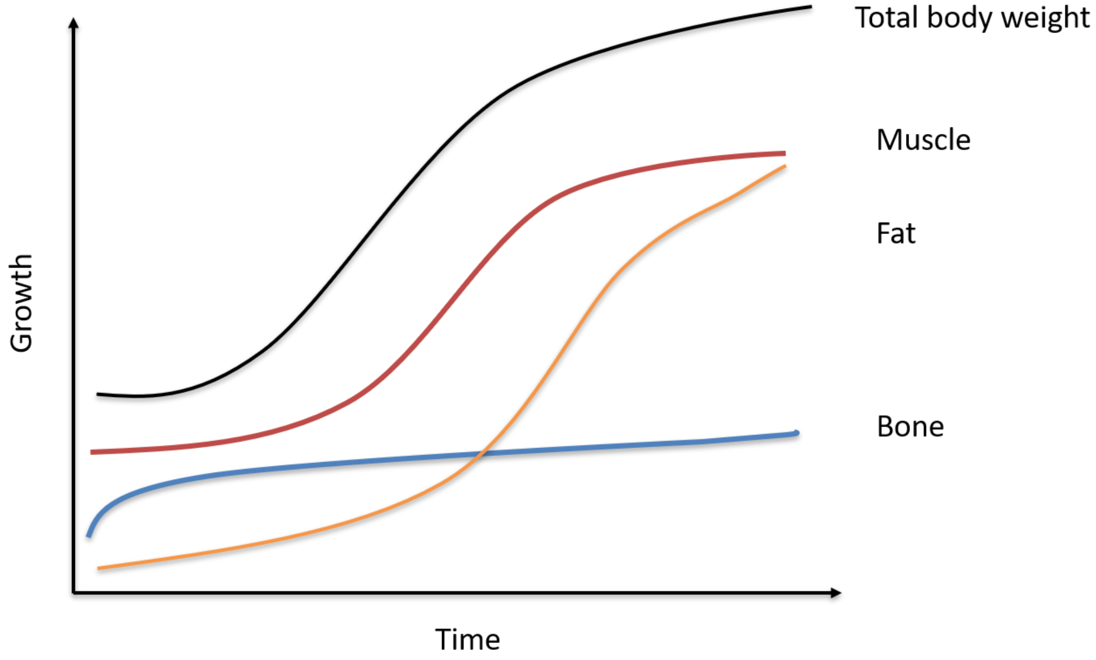
Predictive equation for body weight loss

$$\text{Weight loss in Kg} = -9.3 + W1 \times 0.08 + TFW \times 0.36$$

W1 = Initial body weight (KG)
TFW = Time off feed and water (hours)

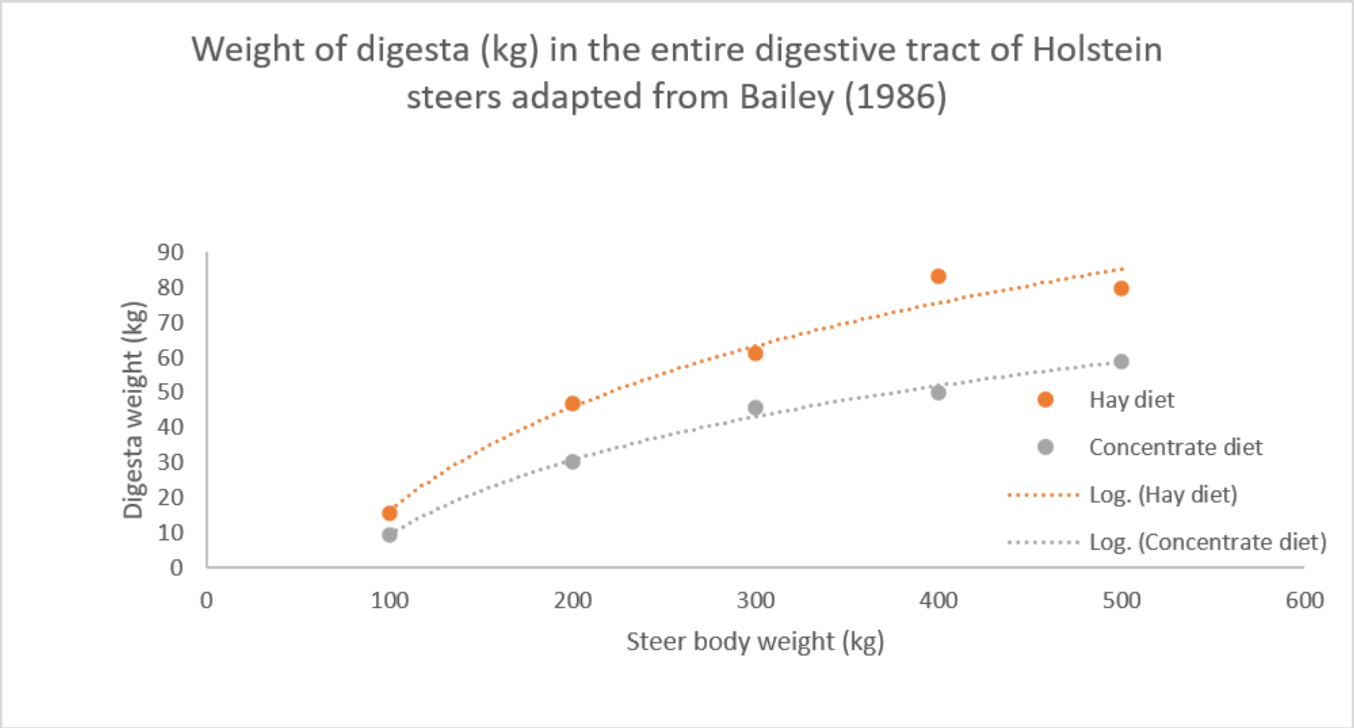
MEAT & LIVESTOCK AUSTRALIA

Growth and development in cattle

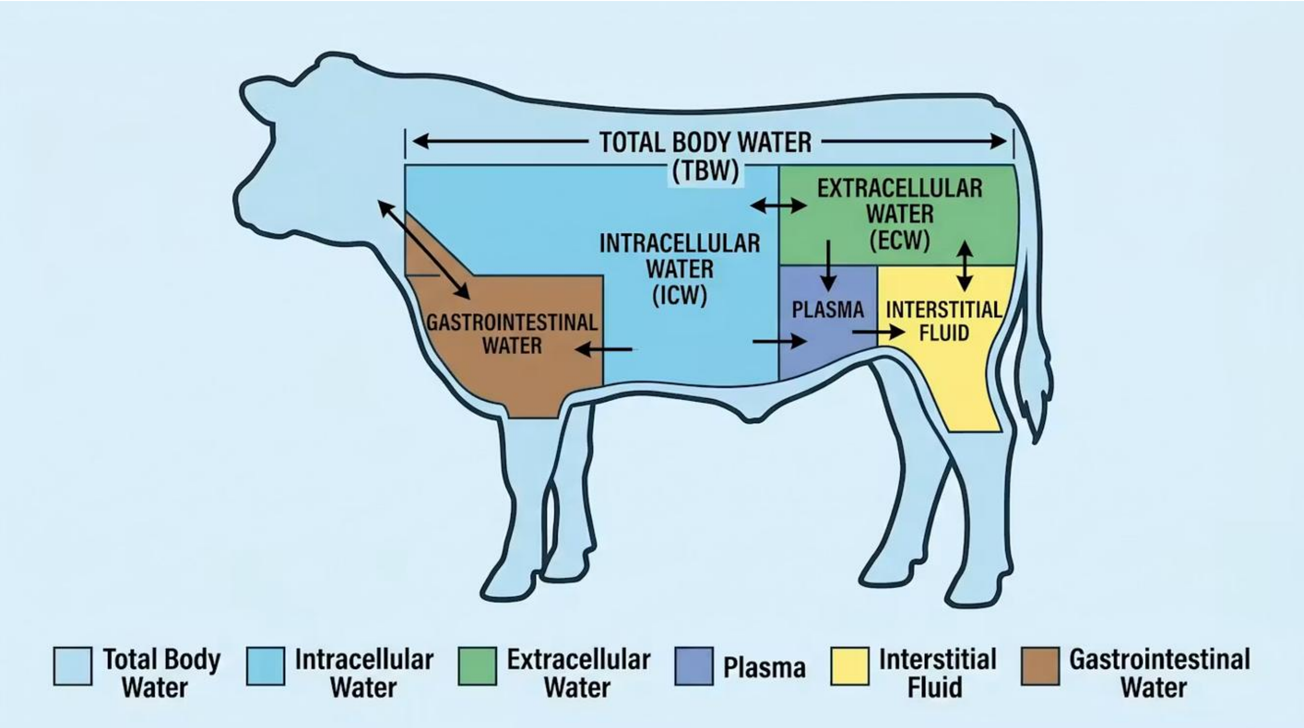


Adapted from Berg and Butterfield (1970)

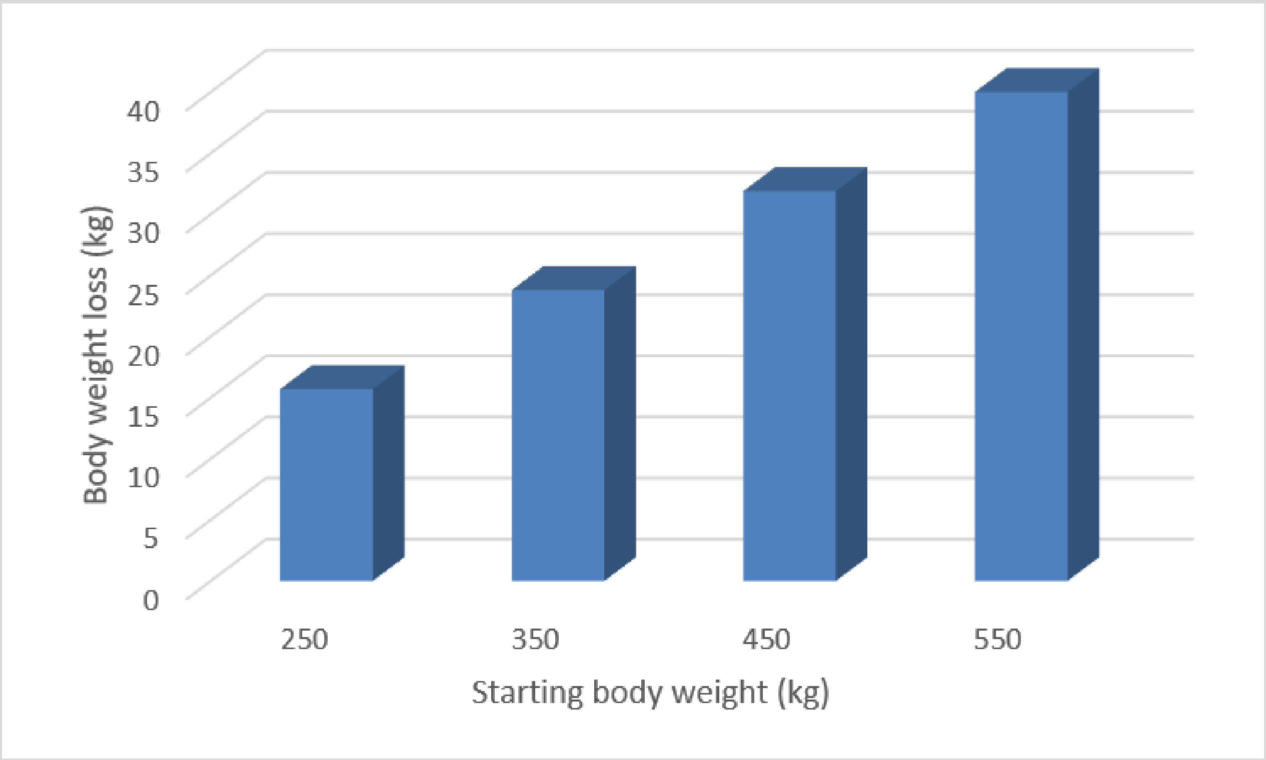
Digesta weight increases with body weight



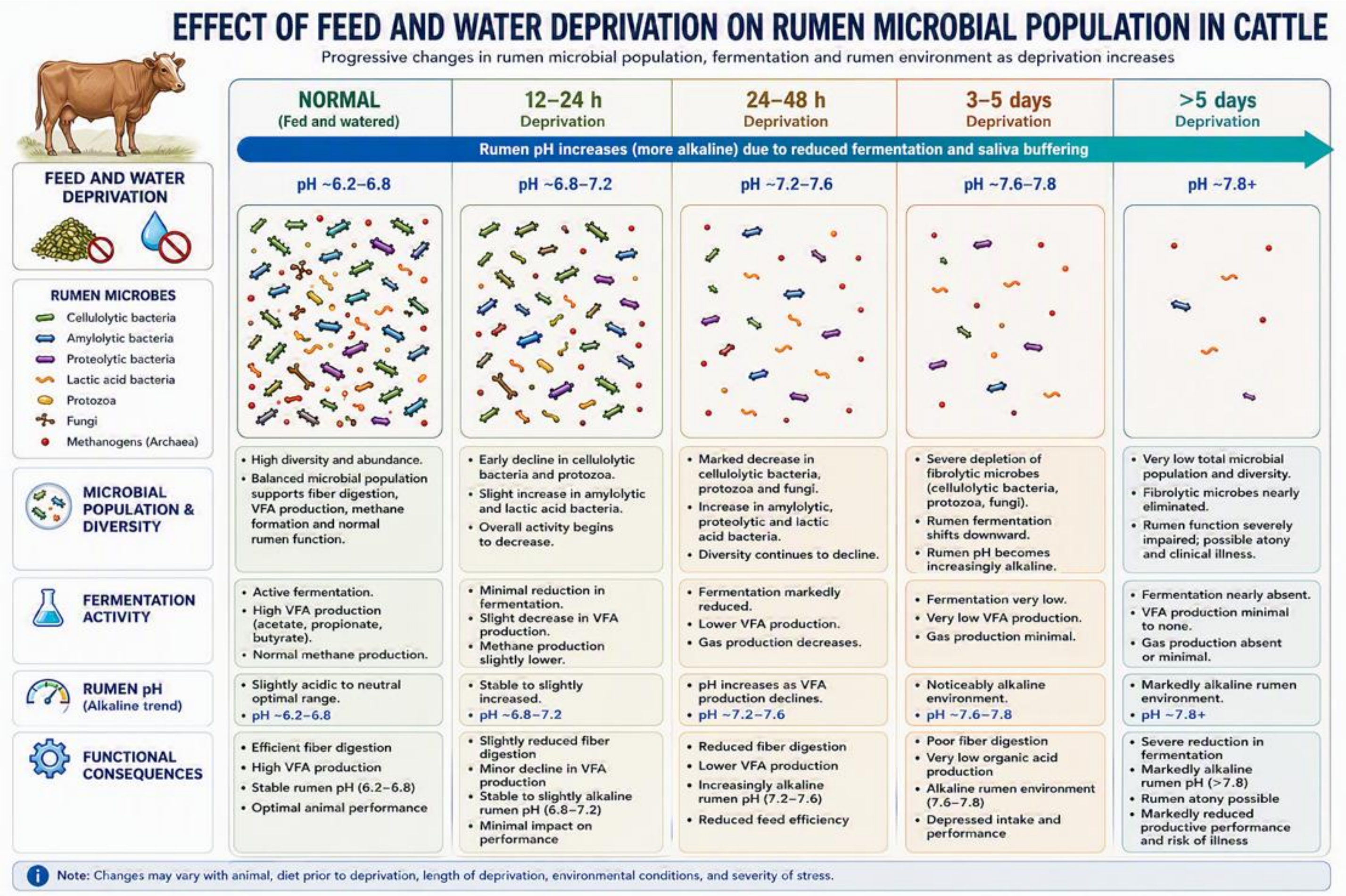
Water compartments in the body



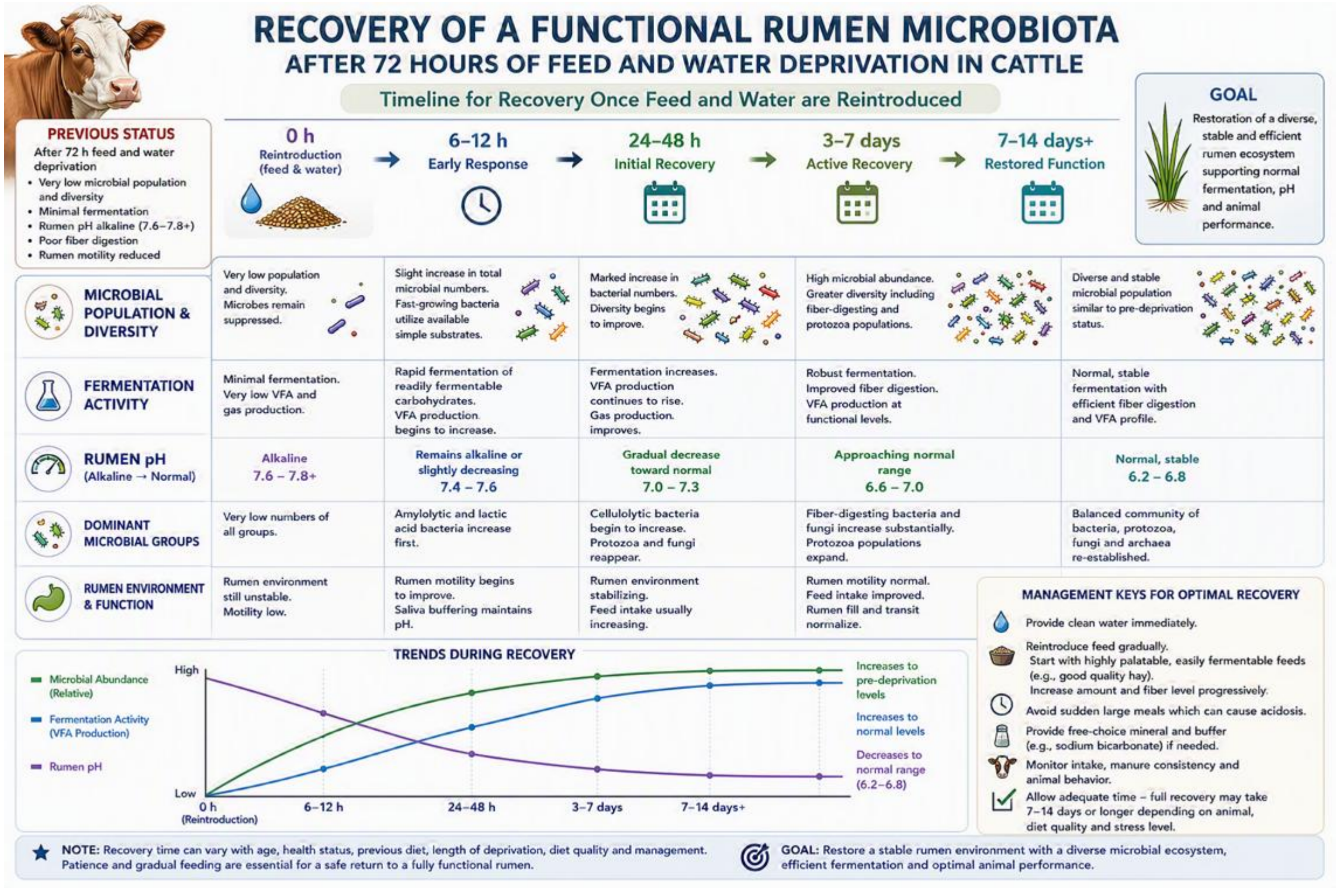
Effect of animal size on body weight loss for 24h feed and water deprivation



MEAT & LIVESTOCK AUSTRALIA

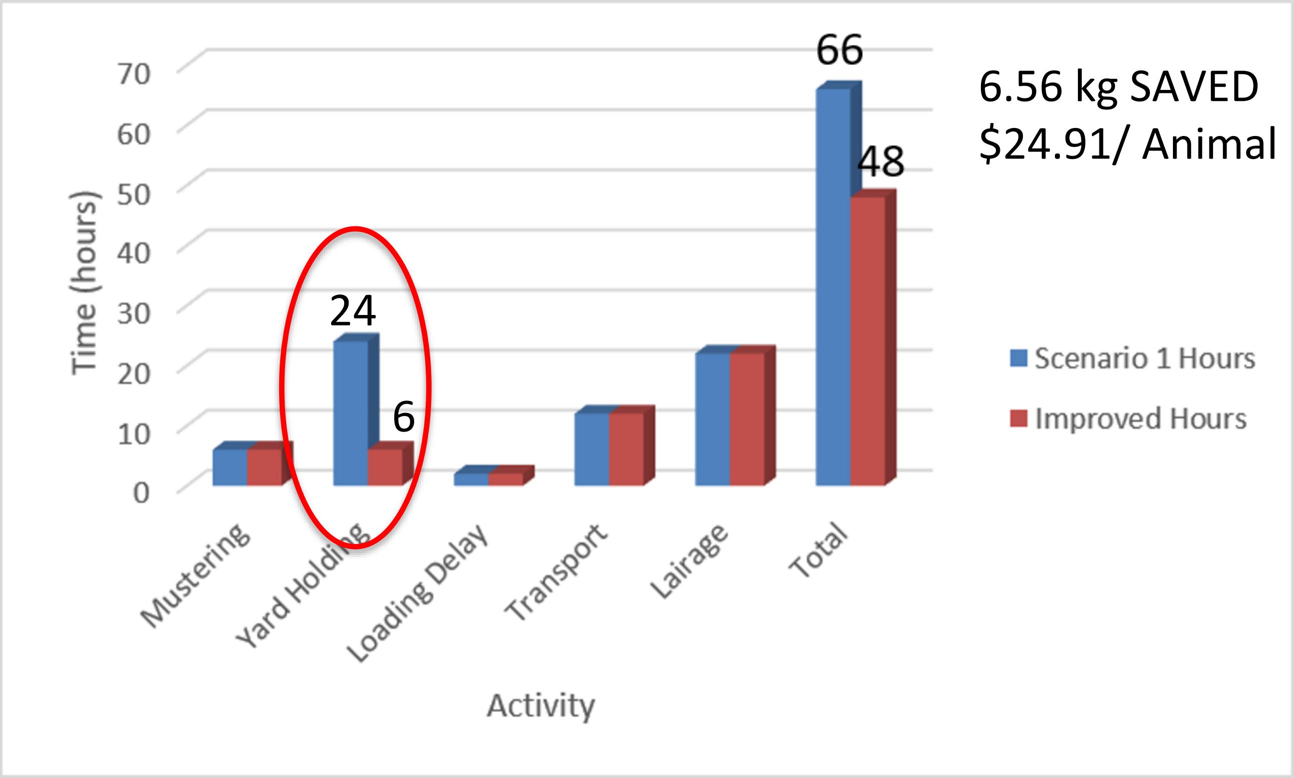


EFFECT OF FEED AND WATER DEPRIVATION ON RUMEN MICROBIAL POPULATION IN CATTLE
Progressive changes in rumen microbial population, fermentation and rumen environment as deprivation increases
FEED AND WATER DEPRIVATION
NORMAL (Fed and watered)
12–24 h Deprivation
24–48 h Deprivation
3–5 days Deprivation
>5 days Deprivation
Rumen pH increases (more alkaline) due to reduced fermentation and saliva buffering
pH ~6.2–6.8
pH ~6.8–7.2
pH ~7.2–7.6
pH ~7.6–7.8
pH ~7.8+
RUMEN MICROBES
Cellulolytic bacteria
Amylolytic bacteria
Proteolytic bacteria
Lactic acid bacteria
Protozoa
Fungi
Methanogens (Archaea)
MICROBIAL POPULATION & DIVERSITY
• High diversity and abundance. • Balanced microbial population supports fiber digestion, VFA production, methane formation and normal rumen function.
• Early decline in cellulolytic bacteria and protozoa. • Slight increase in amylolytic and lactic acid bacteria. • Overall activity begins to decrease.
• Marked decrease in cellulolytic bacteria, protozoa and fungi. • Increase in amylolytic, proteolytic and lactic acid bacteria. • Diversity continues to decline.
• Severe depletion of fibrolytic microbes (cellulolytic bacteria, protozoa, fungi). • Rumen fermentation shifts downward. • Rumen pH becomes increasingly alkaline.
• Very low total microbial population and diversity. • Fibrolytic microbes nearly eliminated. • Rumen function severely impaired; possible atony and clinical illness.
FERMENTATION ACTIVITY
• Active fermentation. • High VFA production (acetate, propionate, butyrate). • Normal methane production.
• Minimal reduction in fermentation. • Slight decrease in VFA production. • Methane production slightly lower.
• Fermentation markedly reduced. • Lower VFA production. • Gas production decreases.
• Fermentation very low. • Very low VFA production. • Gas production minimal.
• Fermentation nearly absent. • VFA production minimal to none. • Gas production absent or minimal.
RUMEN pH (Alkaline trend)
• Slightly acidic to neutral optimal range. • pH ~6.2–6.8
• Stable to slightly increased. • pH ~6.8–7.2
• pH increases as VFA production declines. • pH ~7.2–7.6
• Noticeably alkaline environment. • pH ~7.6–7.8
• Markedly alkaline rumen environment. • pH ~7.8+
FUNCTIONAL CONSEQUENCES
• Efficient fiber digestion • High VFA production • Stable rumen pH (6.2–6.8) • Optimal animal performance
• Slightly reduced fiber digestion • Minor decline in VFA production • Stable to slightly alkaline rumen pH (6.8–7.2) • Minimal impact on performance
• Reduced fiber digestion • Lower VFA production • Increasingly alkaline rumen pH (7.2–7.6) • Reduced feed efficiency
• Poor fiber digestion • Very low organic acid production • Alkaline rumen environment (7.6–7.8) • Depressed intake and performance
• Severe reduction in fermentation • Markedly alkaline rumen pH (>7.8) • Rumen atony possible • Markedly reduced productive performance and risk of illness
Note: Changes may vary with animal, diet prior to deprivation, length of deprivation, environmental conditions, and severity of stress.



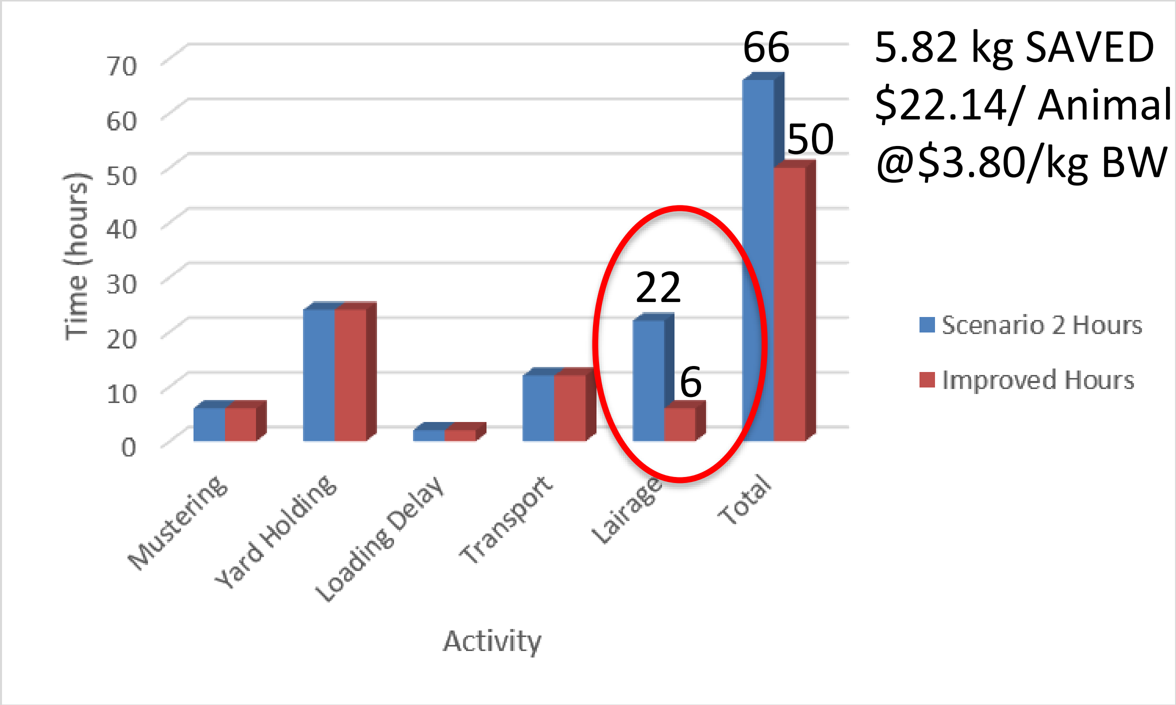
RECOVERY OF A FUNCTIONAL RUMEN MICROBIOTA
AFTER 72 HOURS OF FEED AND WATER DEPRIVATION IN CATTLE
Timeline for Recovery Once Feed and Water are Reintroduced
PREVIOUS STATUS
After 72 h feed and water deprivation
• Very low microbial population and diversity
• Minimal fermentation
• Rumen pH alkaline (7.6–7.8+)
• Poor fiber digestion
• Rumen motility reduced
0 h
Reintroduction (feed & water)
6–12 h
Early Response
24–48 h
Initial Recovery
3–7 days
Active Recovery
7–14 days+
Restored Function
GOAL
Restoration of a diverse, stable and efficient rumen ecosystem supporting normal fermentation, pH and animal performance.
MICROBIAL POPULATION & DIVERSITY
Very low population and diversity. Microbes remain suppressed.
Slight increase in total microbial numbers. Fast-growing bacteria utilize available simple substrates.
Marked increase in bacterial numbers. Diversity begins to improve.
High microbial abundance. Greater diversity including fiber-digesting and protozoa populations.
Diverse and stable microbial population similar to pre-deprivation status.
FERMENTATION ACTIVITY
Minimal fermentation. Very low VFA and gas production.
Rapid fermentation of readily fermentable carbohydrates. VFA production begins to increase.
Fermentation increases. VFA production continues to rise. Gas production improves.
Robust fermentation. Improved fiber digestion. VFA production at functional levels.
Normal, stable fermentation with efficient fiber digestion and VFA profile.
RUMEN pH (Alkaline → Normal)
Alkaline 7.6 – 7.8+
Remains alkaline or slightly decreasing 7.4 – 7.6
Gradual decrease toward normal 7.0 – 7.3
Approaching normal range 6.6 – 7.0
Normal, stable 6.2 – 6.8
DOMINANT MICROBIAL GROUPS
Very low numbers of all groups.
Amylolytic and lactic acid bacteria increase first.
Cellulolytic bacteria begin to increase. Protozoa and fungi reappear.
Fiber-digesting bacteria and fungi increase substantially. Protozoa populations expand.
Balanced community of bacteria, protozoa, fungi and archaea re-established.
RUMEN ENVIRONMENT & FUNCTION
Rumen environment still unstable. Motility low.
Rumen motility begins to improve. Saliva buffering maintains pH.
Rumen environment stabilizing. Feed intake usually increasing.
Rumen motility normal. Feed intake improved. Rumen fill and transit normalize.
TRENDS DURING RECOVERY
Microbial Abundance (Relative)
Fermentation Activity (VFA Production)
Rumen pH
High
Low
0 h (Reintroduction)
6–12 h
24–48 h
3–7 days
7–14 days+
Increases to pre-deprivation levels
Increases to normal levels
Decreases to normal range (6.2–6.8)
MANAGEMENT KEYS FOR OPTIMAL RECOVERY
Provide clean water immediately.
Reintroduce feed gradually. Start with highly palatable, easily fermentable feeds (e.g., good quality hay). Increase amount and fiber level progressively.
Avoid sudden large meals which can cause acidosis.
Provide free-choice mineral and buffer (e.g., sodium bicarbonate) if needed.
Monitor intake, manure consistency and animal behavior.
Allow adequate time – full recovery may take 7–14 days or longer depending on animal, diet quality and stress level.
NOTE: Recovery time can vary with age, health status, previous diet, length of deprivation, diet quality and management. Patience and gradual feeding are essential for a safe return to a fully functional rumen.
GOAL: Restore a stable rumen environment with a diverse microbial ecosystem, efficient fermentation and optimal animal performance.

Case study 1 Assembly yards



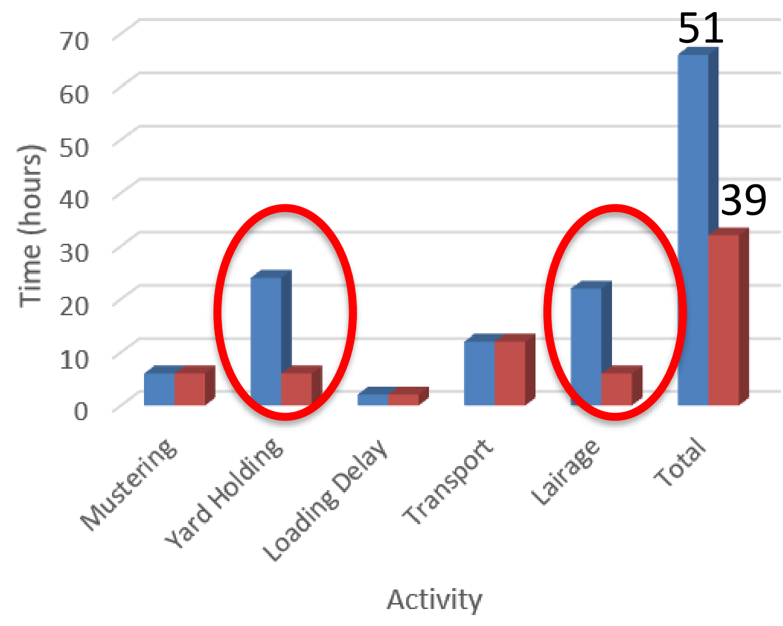
MEAT & LIVESTOCK AUSTRALIA

Case study 2 - Lairage



MEAT & LIVESTOCK AUSTRALIA

Case study 3 – Assembly and Lairage



12.38 kg SAVED
$47.05/ Animal
@$3.80/kg BW

MEAT & LIVESTOCK AUSTRALIA

Preparation of cattle

- [Best practice guidelines for transporting cattle | Meat & Livestock Australia]
- Communicate the journey conditions (driver, receiver)
- Feed cattle at assembly yards
  - Minimum 24 hours on good quality hay (10MJ/kg DM, 2% of Body weight, adequate trough space - 200mm/head)
  - Preferably 48 hours on good quality hay
  - 400 kg steer x 2% = 8kg DM hay/24 hours
  - Provide clean water (check refill time and trough space is adequate for group - 30mm/head)
- Have adequate feed on offer at 8:00am and 4:00pm for the group

MEAT & LIVESTOCK AUSTRALIA

Take home messages

- **Producers**
  - Maintain ad libitum feed and water access as close as possible to departure.
  - Use the equation to calculate body weight loss for the journey
  - Use the equation as fair objective criteria for predicting shrink in kgs
- **Northern Australia**
  - Long distances amplify total feed and water deprivation time.
  - Efficient mustering
  - Reduced yard waiting times
  - Improved scheduling
  - Undelayed unloading

Take home messages

- **Feedlots**
  - Minimise induction delays
  - Immediate access to clean water
  - Early feed delivery
- **Processors**
  - Reduced lairage duration where feasible
  - Improved logistics planning

- Transport does not cause body weight loss

MEAT & LIVESTOCK AUSTRALIA

Preparing livestock for transport *checklist*

[MLA - Preparing livestock for transport checklist]

Do you have any questions?

MEAT & LIVESTOCK AUSTRALIA