Liver Abscesses: New Thinking on an Old Topic

Dr. Scott Laudert

FEEDING QUALITY FORUM

Liver Abscesses: On Radar Screen a Long Time

- Concern of beef industries for 70 yrs
- 1944 research report on ulcerative rumen lesions
  - Then 1954 - antibiotic reduces abscesses in fattened cattle and association of rumenitis-liver abscess complex
- Tylan® approved for reduction of incidence in 1973
- Research efforts continue: Universities & Corporate

Why are Livers Condemned?

- Abscess
- Parasite
- Disease
- Contamination

Liver Condemnation

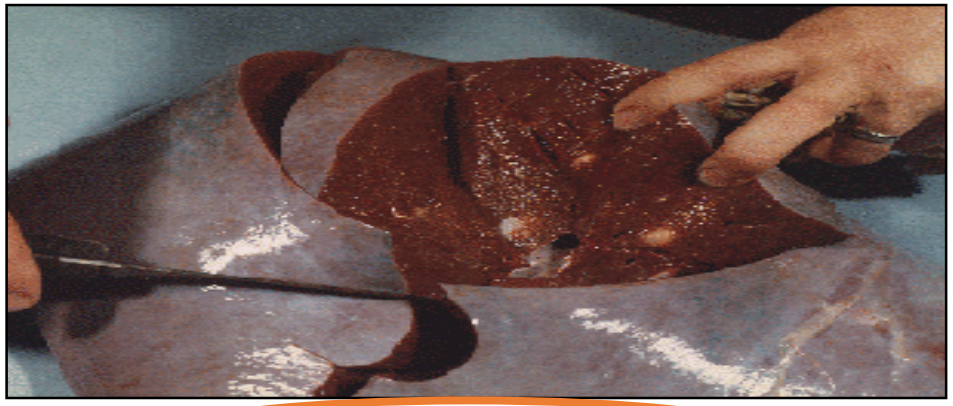
- Concern among beef packers: “Condemnation rate too high”
  - Number 6 and number 2 concerns in ‘91 and ‘95 NBQ Audits
- Averaged 24% in first 5 Audits, increasing to 31% in 2016
  - Holstein steers in 2016 = 20% vs 6% from 1991 to 2011
- Liver Abscesses = 46% of condemnations in 1991 NBQA but increased to 66% (Herrick, 2018)

Degree of Severity

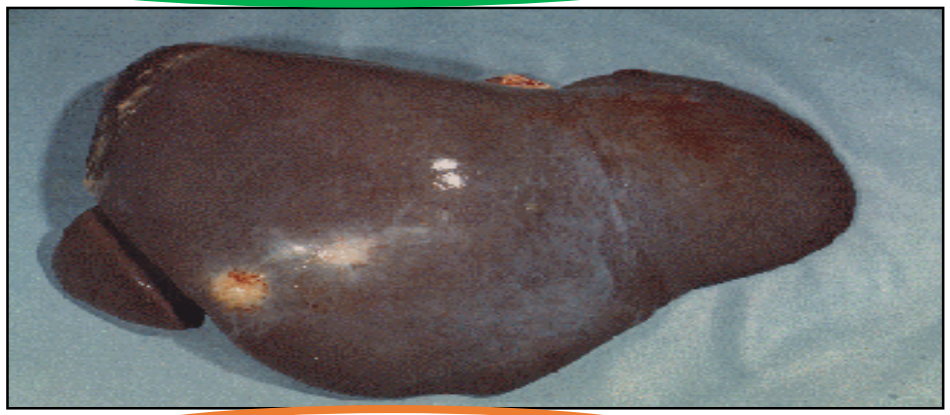
- Normal or none
- Minor
  - Smaller than a pencil eraser to size of golf ball
  - All abscesses are condemned, No trimming
- Severe
  - One or several large abscesses (size of a hen's egg and up to size of a softball)

Liver Abscess Severity Categories

Normal, healthy, edible



Minor



Minor

Severe

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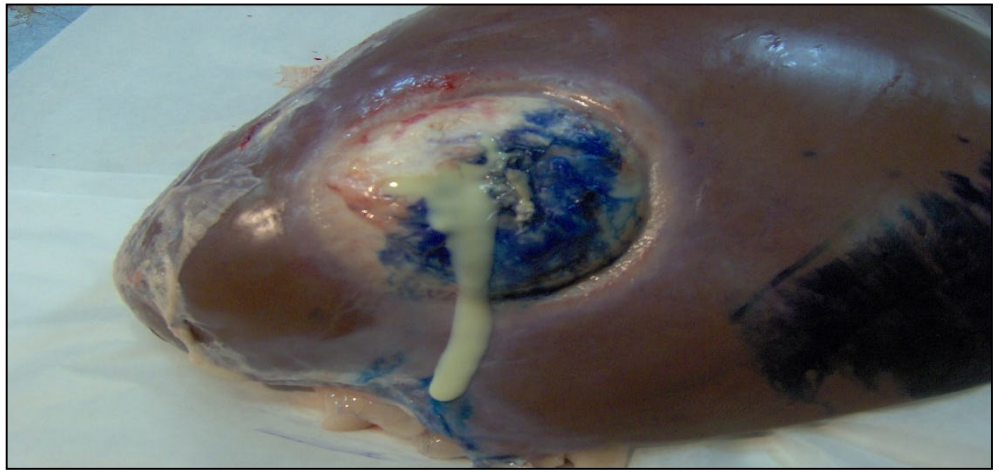
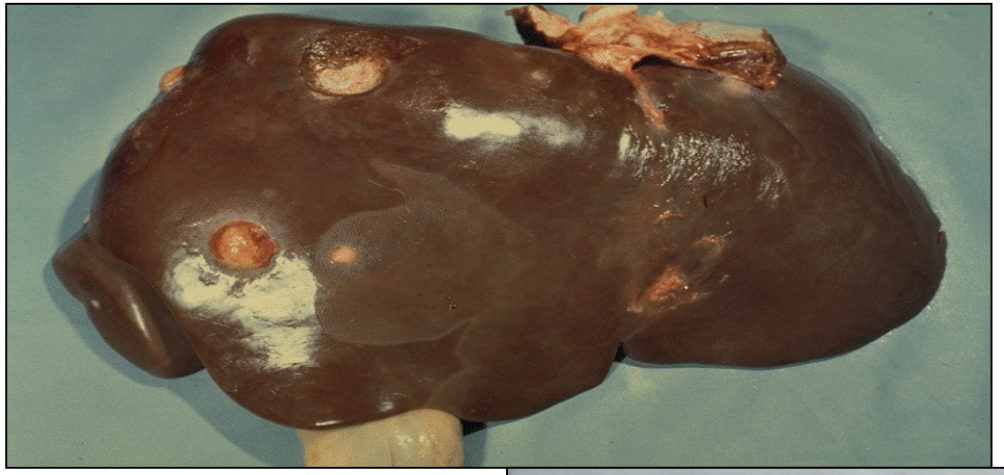
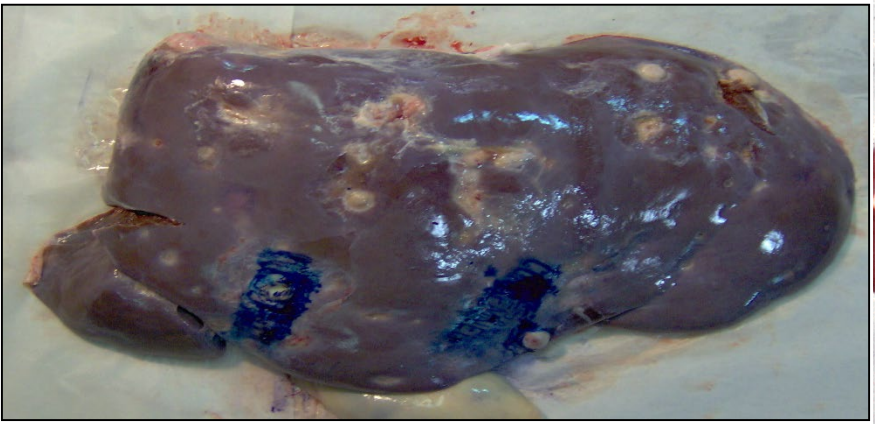
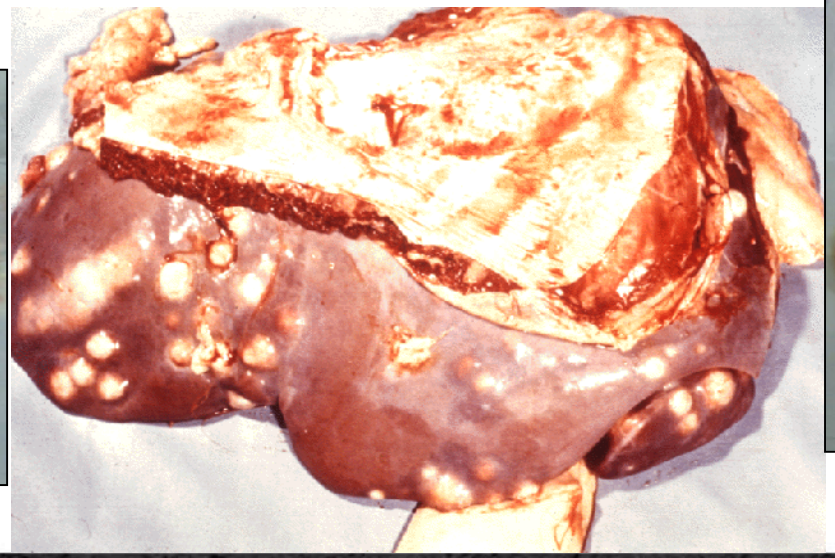
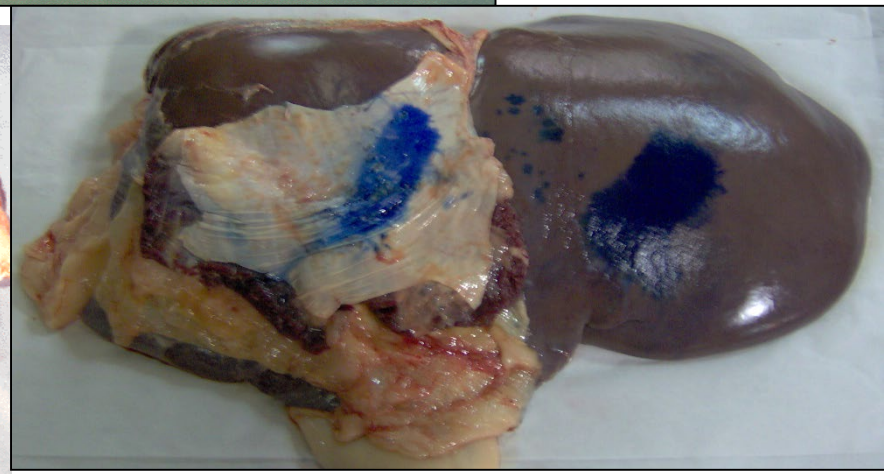
Nasty Severe Abscesses











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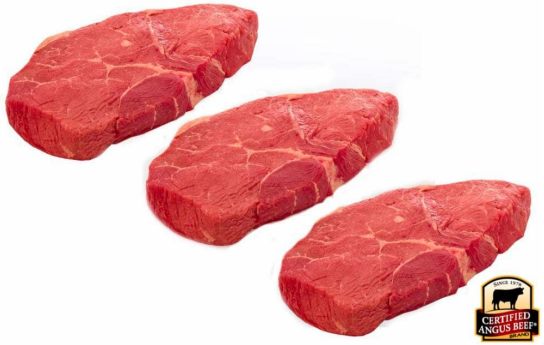
Negative Effects of Abscesses on Packer

- Severe abscesses at evisceration
  - Frequently rupture, contaminating viscera and surrounding tissues with pus
  - Often adhere to the diaphragm, rumen and/or peritoneum
  - Carcasses can be trimmed of 15+ lb of saleable weight
- Loss of entire viscera
- Entire slaughter process stopped to trim or bag to contain contamination
- Carcasses often required to be railed-off
  - Additional time required for zero tolerance trimming
- Losses are a combination of time, labor and saleable product
- Total annual liver and viscera loss ~ $60 million (Herrick, 2018)

Performance of Animals with Liver Abscesses

- Performance of animals with Minor abscesses is not different
  - Equal to No abscess
- Performance of animal with Severe abscess can be greatly affected
  - Feed intake: -5%
  - Daily gain: -10%
  - Carcass weight: -10%
  - Dressing percent: - 2%
    - Marbling score: Inconsistent reduction
    - Quality Grade: Not greatly different



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Liver Abscess Incidence in Feedlot Cattle[a]

	Beef Steers		Holstein Steers	
Time Period	% Total	% Severe	% Total	% Severe
1999 to 2008	13	5	17	8
2014 to 2018	18	8	46	29

[a] EAH Liver Check Service

Wow, why such a big Holstein increase?

- Beef steers average 2-3% higher than heifers
- Calf-fed Holsteins 2.5x beef steers

Calf-fed Holsteins – Why Abscesses so High

- Yearlings vs Calf-fed
- Lack of colostrum quantity and quality; fed to replacements not bulls
- Calves receive little roughage, critical to rumen development
- Many get a late start on control measures, day 1 is not to soon
- Fed a milk and concentrate diet prior to entering the feedlot
- Lack of knowledge about how calf-feds are raised and cared for
- A common explanation is days on feed, 350+ vs +/-200 days
- Bacteria from Holstein and beef steers are not different and not the reason for higher prevalence and severity in Holsteins (Amachawadi et al, 2017)

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- Beef steers average 2-3% higher than heifers
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- Could the recent abscess increases in beef steers be the result of genetic selection for increased performance and improved carcass traits also selecting for increased feed intake and liver abscesses

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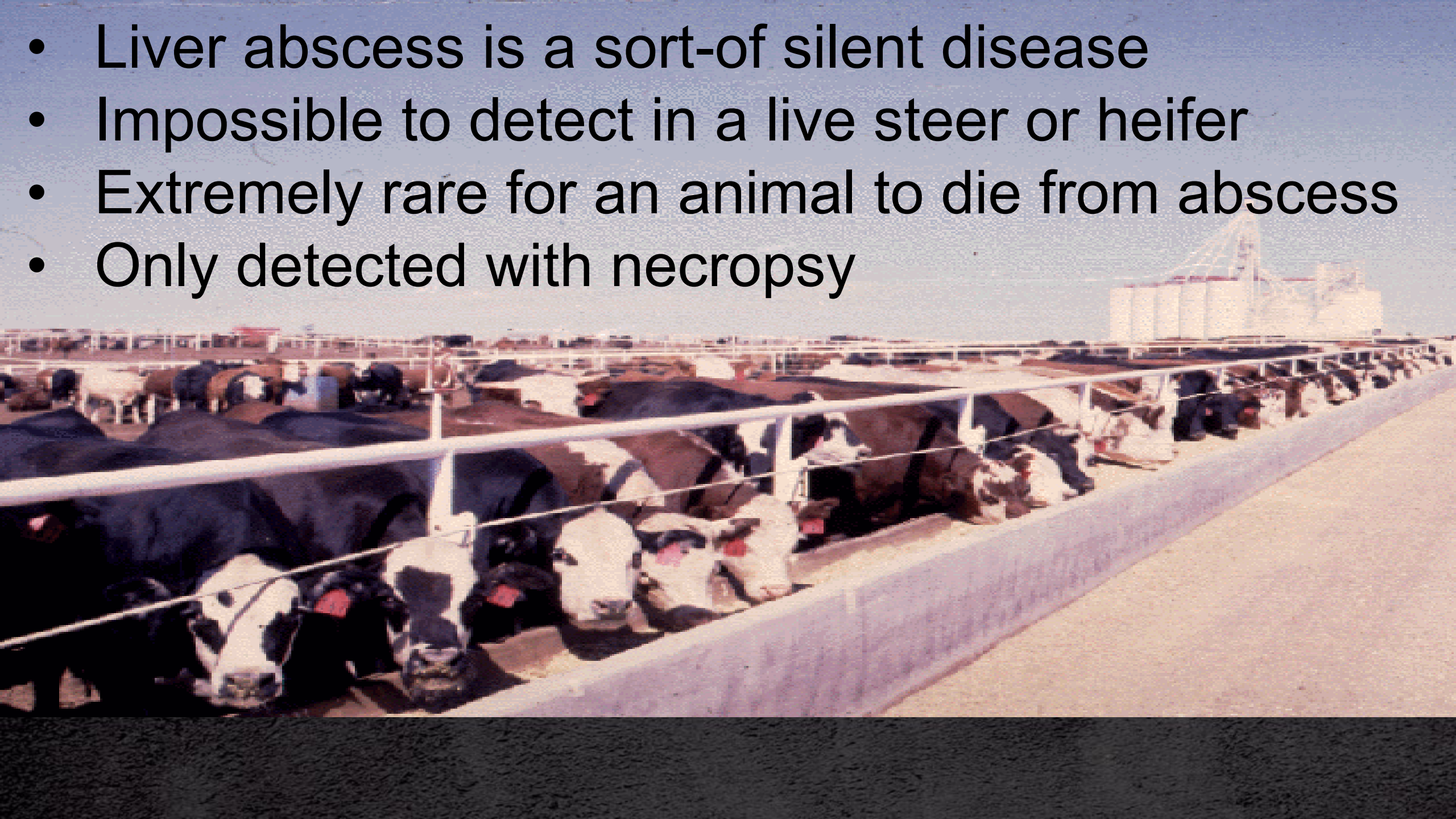
- Liver abscess is a sort-of silent disease
- Impossible to detect in a live steer or heifer
- Extremely rare for an animal to die from abscess
- Only detected with necropsy

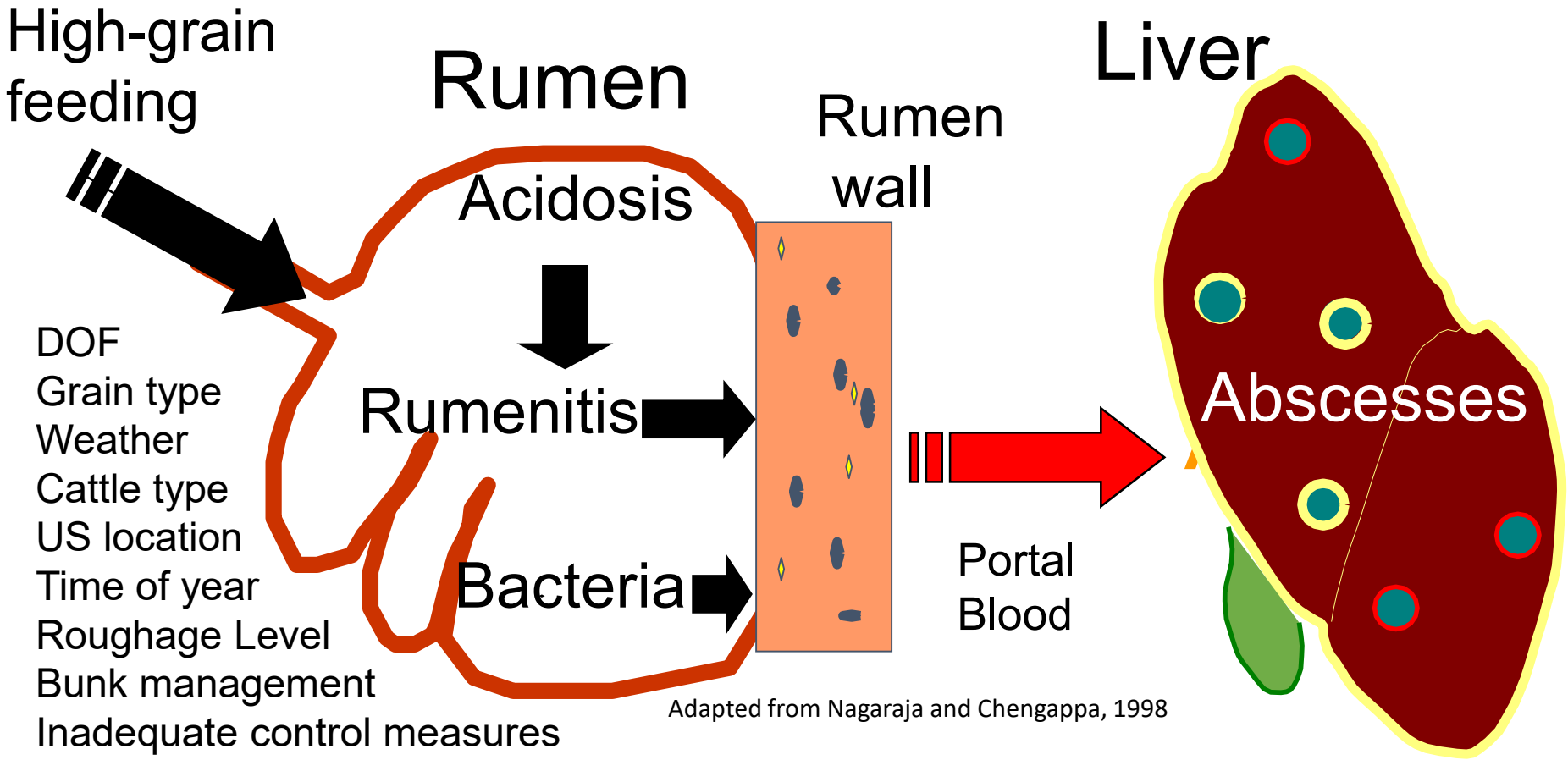


- Colorado State researchers found no differences in stress-related physiological parameters or mobility score of steers with no or varying degrees of abscesses; demonstrating no effect of liver abscess on the welfare or well-being of feedlot cattle
(Baier F., et al, 2019)

Liver Abscess Development

What Causes Abscessed?

A must know to implement or develop new control measures.



Adapted from Nagaraja and Chengappa, 1998

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Liver Abscess Development

High-grain feeding

DOF
Grain type
Weather
Cattle type
US location
Time of year
Roughage Level
Bunk management
Inadequate control measures

Rumen

Acidosis

Rumenitis

Bacteria

Rumen wall

Portal Blood

Liver

Abscesses

Adapted from Nagaraja and Chengappa, 1998

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High Grain Diets

- Often lead to production of vast quantities of lactic acid and volatile fatty acids
- Lactic acid and VFAs result in low rumen pH or acidosis
- Acidosis: Adverse condition unfavorable for efficient bacterial growth and function
- Acidosis: Causes cell damage, erosion and ulceration of the rumen wall; **Rumenitis**

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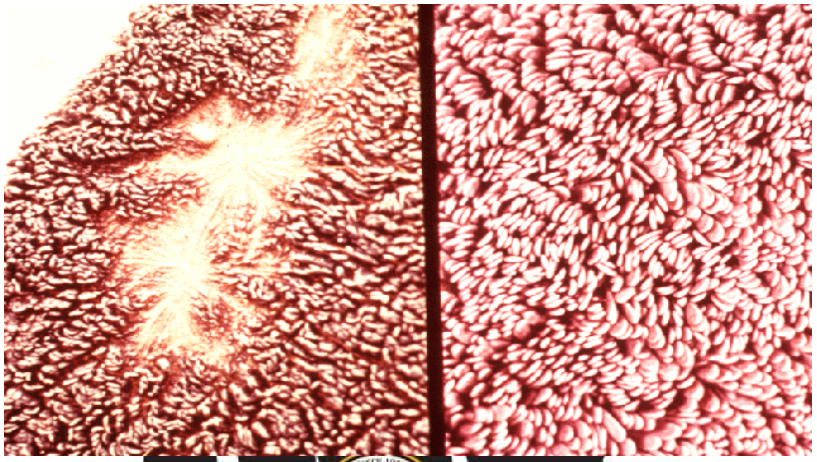
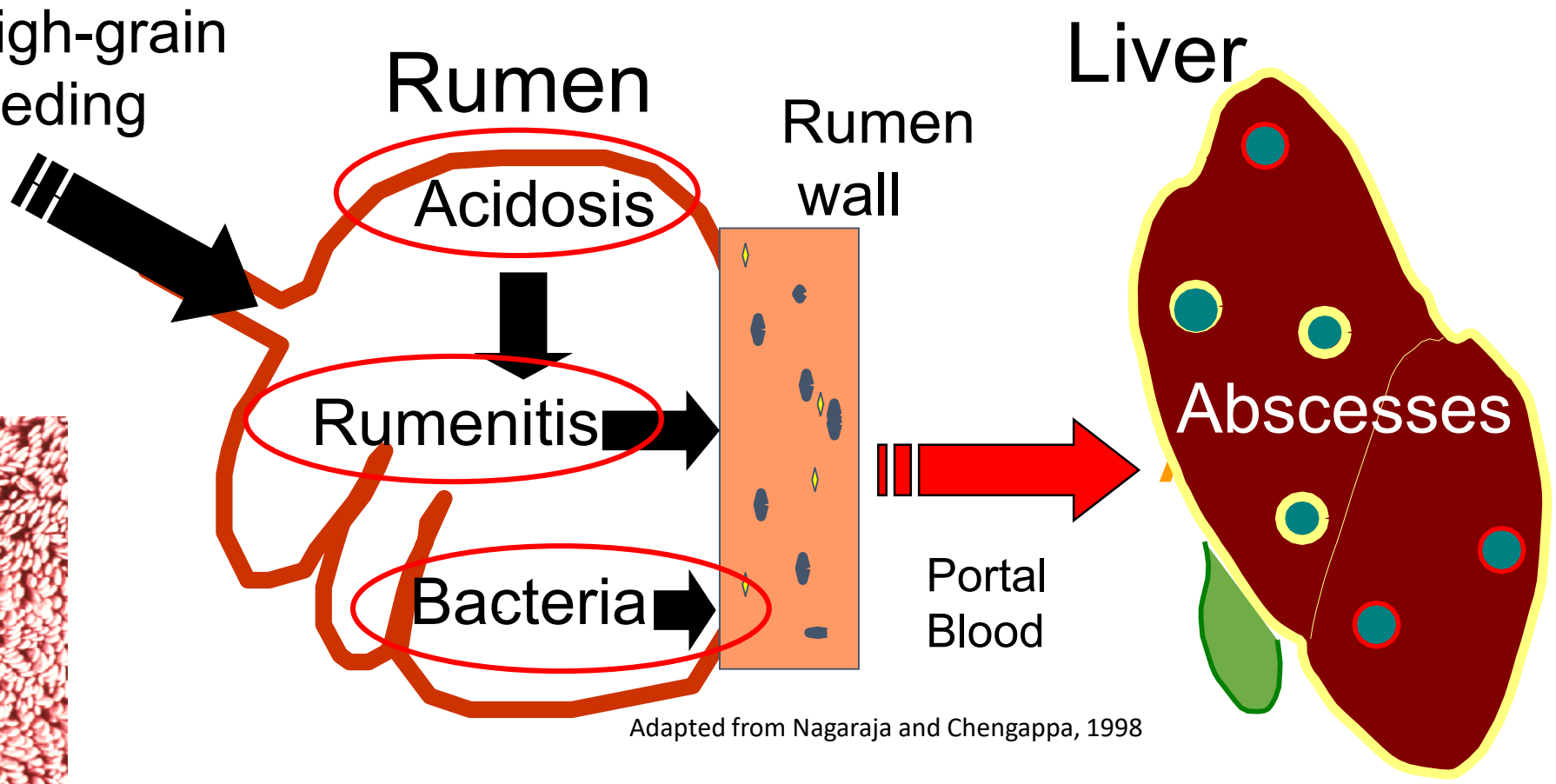
Liver Abscess Development





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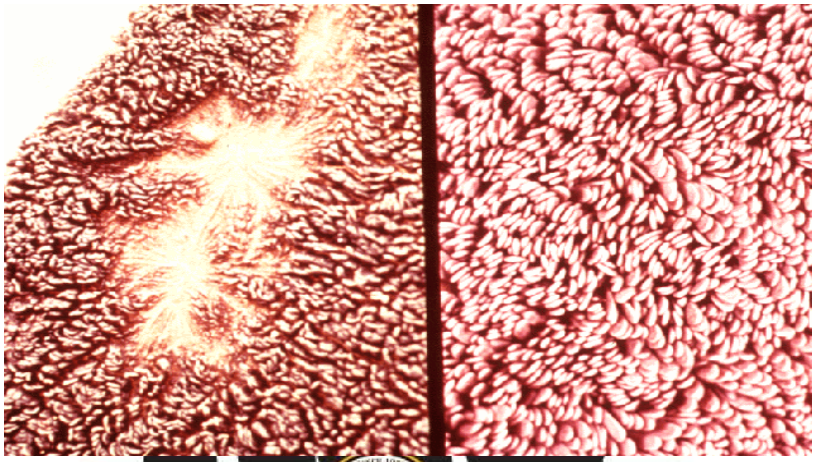
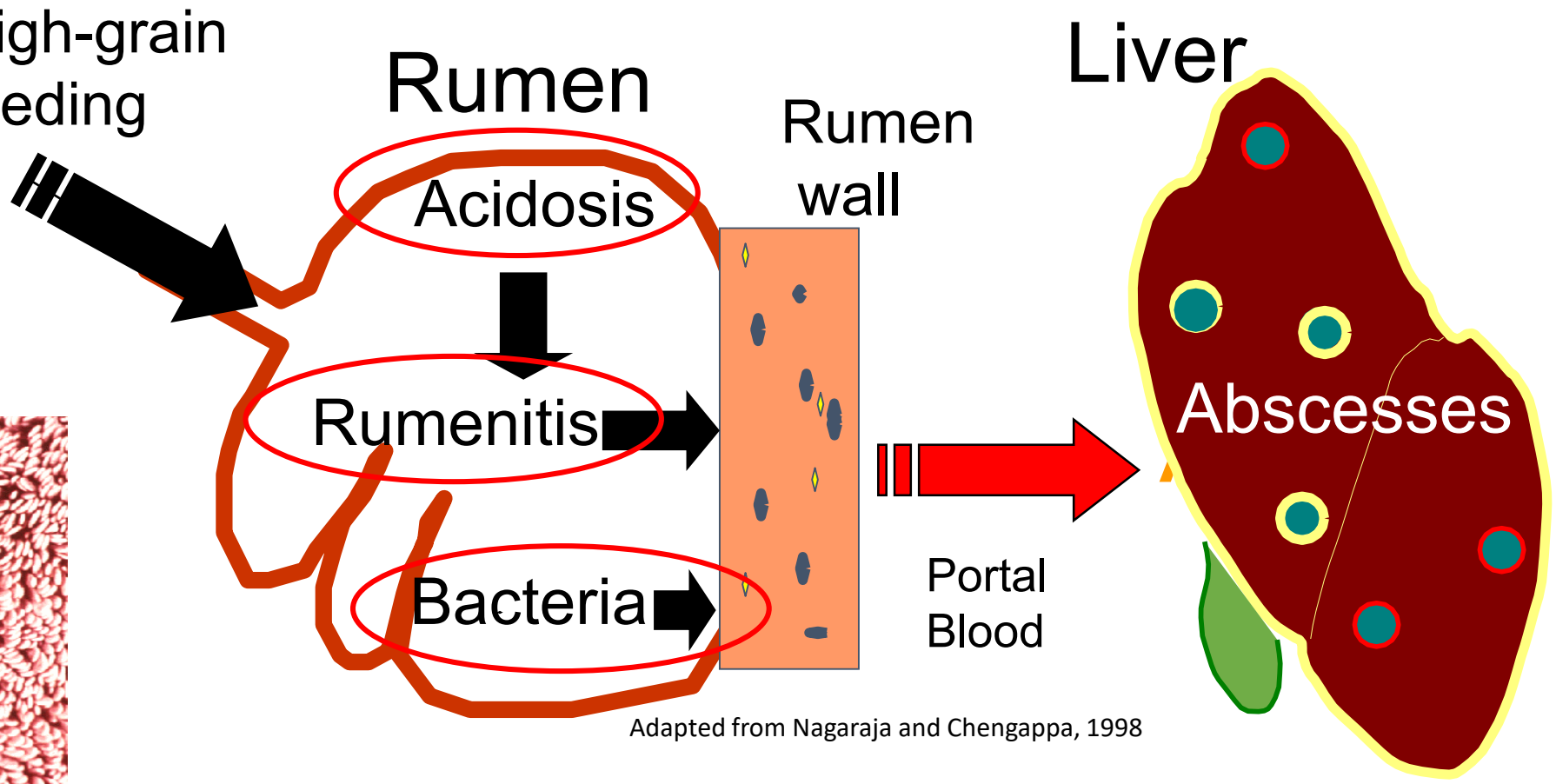
Bacteriologic Studies

- Well documented that 2 bacteria cause liver abscesses; *Fusobacterium necrophorum* and *Trueperella pyogenes*
- Lactic acid is primary energy source *F necrophorum*
- *F* n*ecrophorum* possess strong leukotoxin and virulence; cell surface proteins allow rumen wall attachment
- *F necrophorum* ideally suited to cause abscesses

Liver Abscess Development





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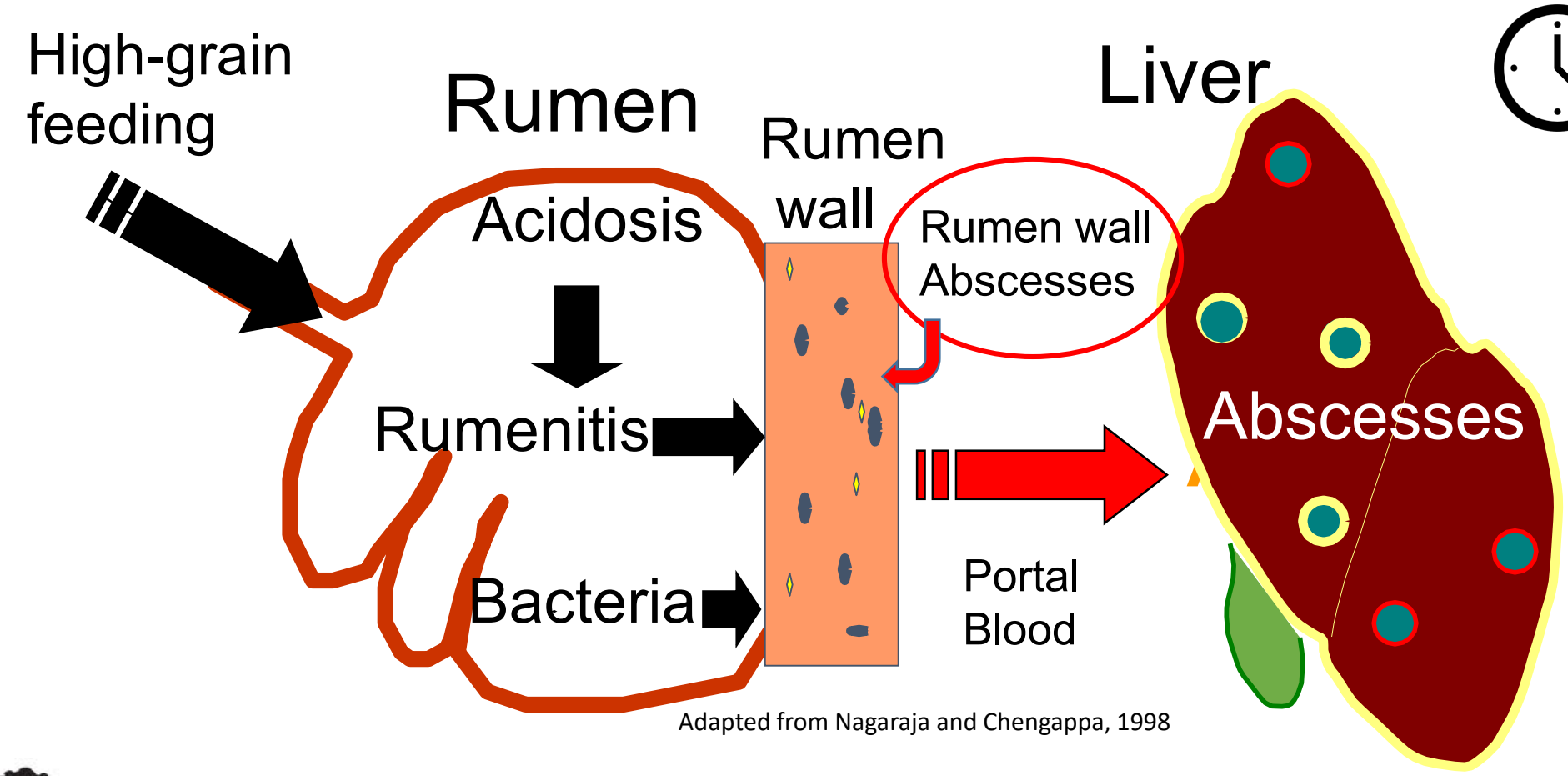
Rumen Wall

- Bacterial infection leads to rumen wall abscesses
- Bacterium from rumen wall abscesses enter the liver via portal blood circulation and are filtered out
- Liver is a very defensive and resilient organ
- Liver abscesses number and size are dependent on the number of bacteria entering the liver at a given time

Liver Abscess Development



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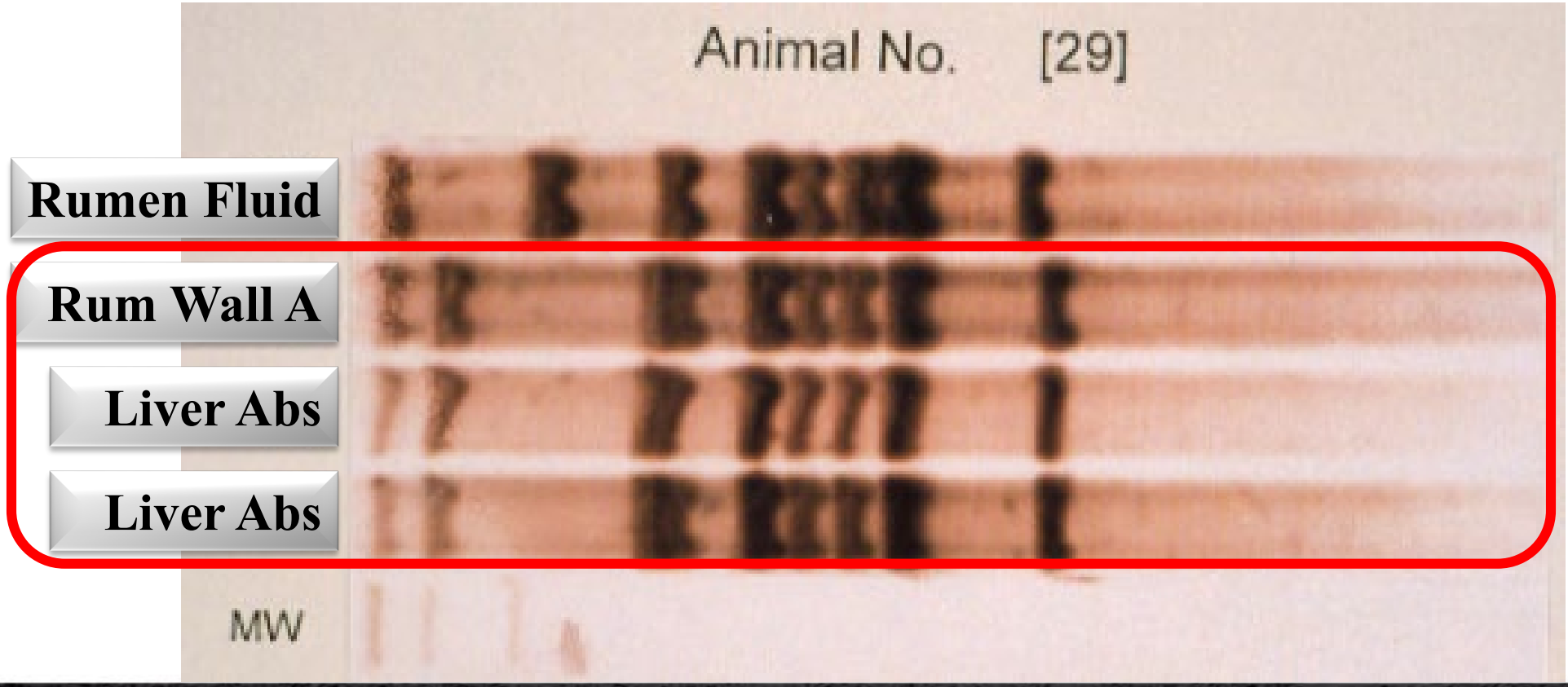
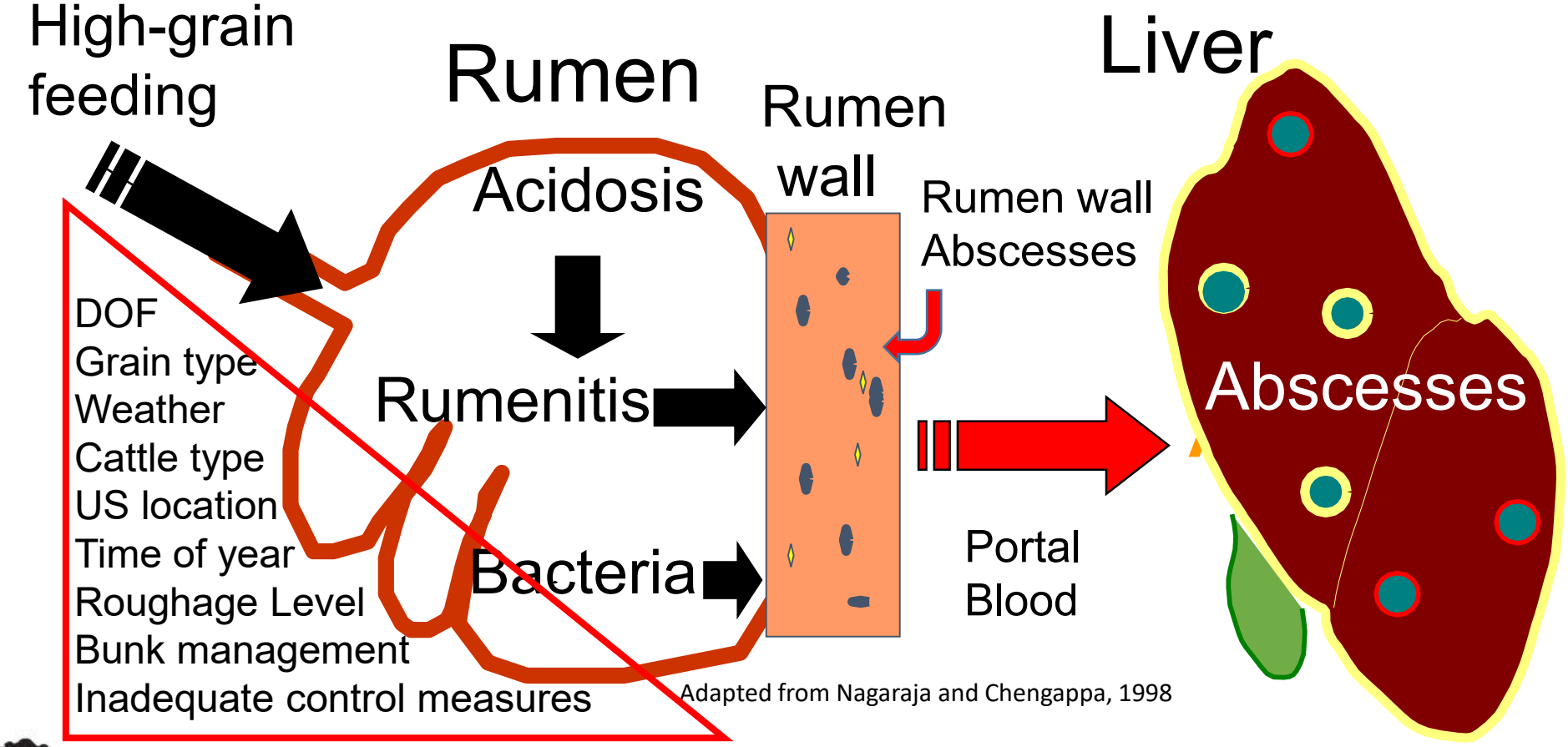
F necrophorum recovered from liver abscesses, fingerprint closely with *F necrophorum* isolated from rumen wall abscesses but not with those isolated from rumen contents



Liver Abscess Development



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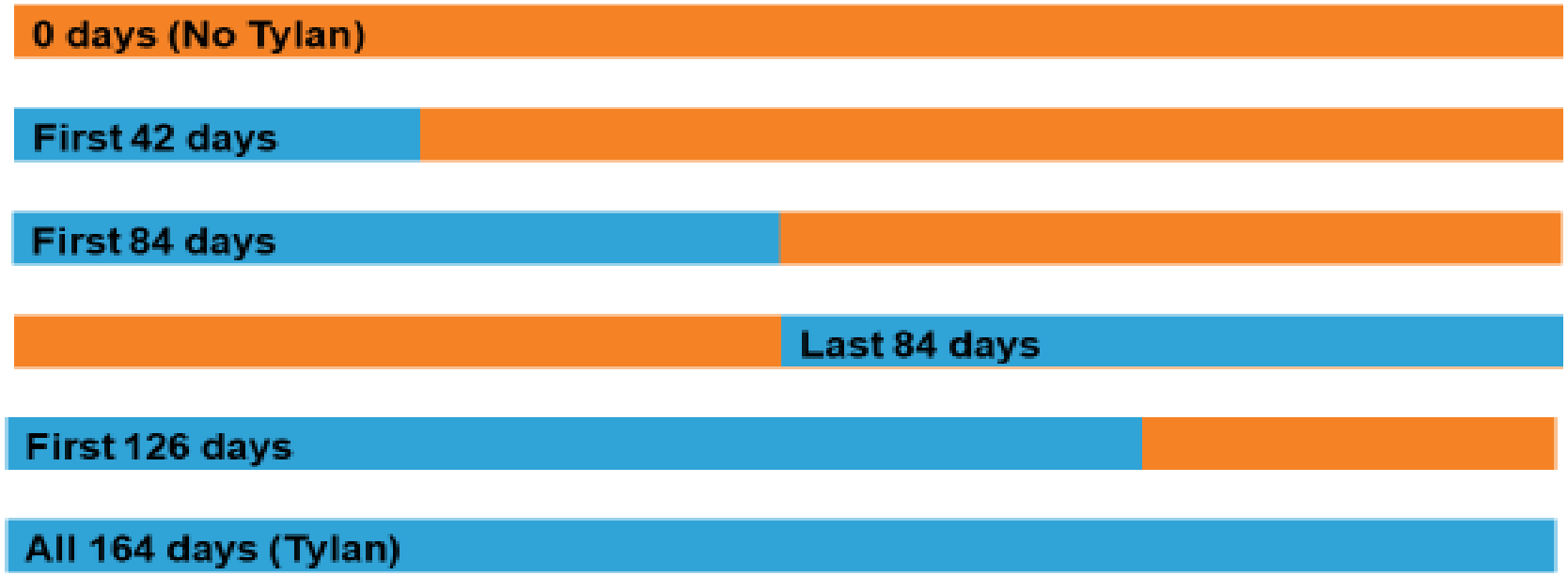
Other Factors

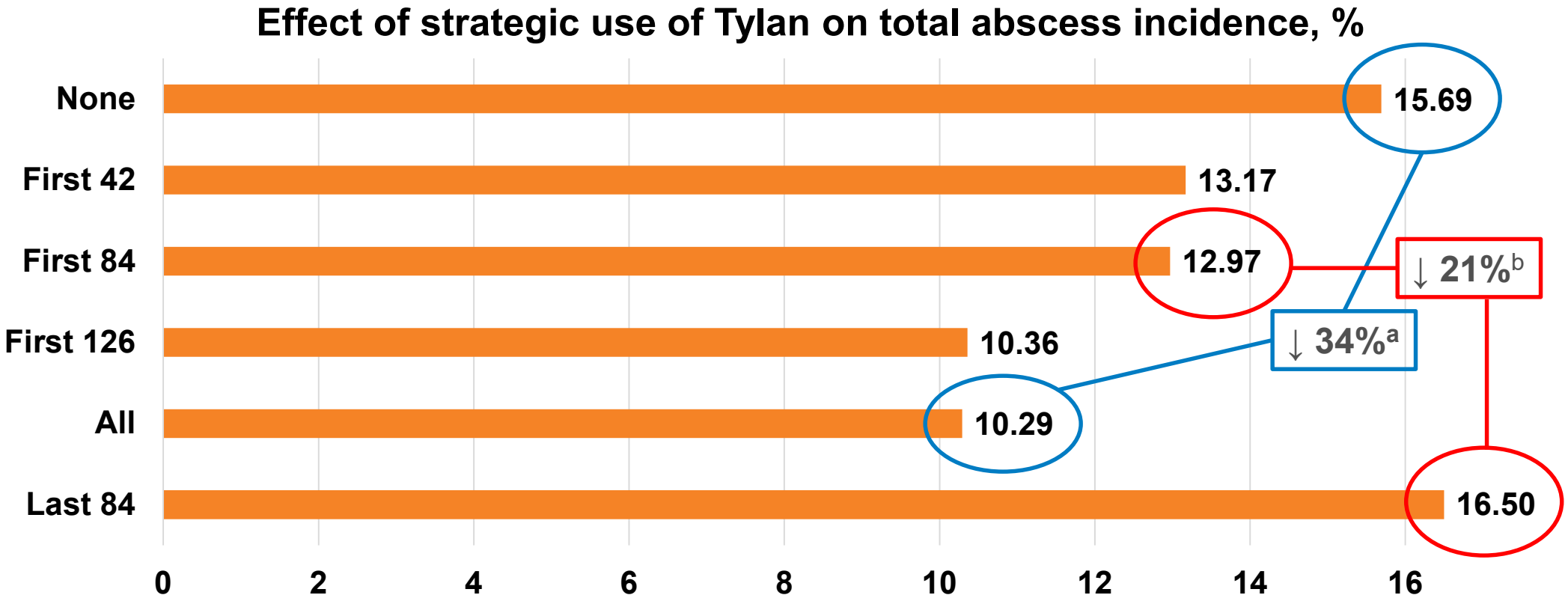
- Cattle are predisposed to abscess development early in the feeding period
- Abscesses likely form during the middle third of the feeding period
- It is critical to implement management practices and control measures at the very beginning of finishing
- Calf-fed Holsteins should be started on control as early as possible
- Growing cattle fed a limited intake high-energy ration are at risk

Strategic use of Tylan to control liver abscess condemnation in finishing beef cattle



Elanco Animal Health. Data on File.

Liver abscess incidence

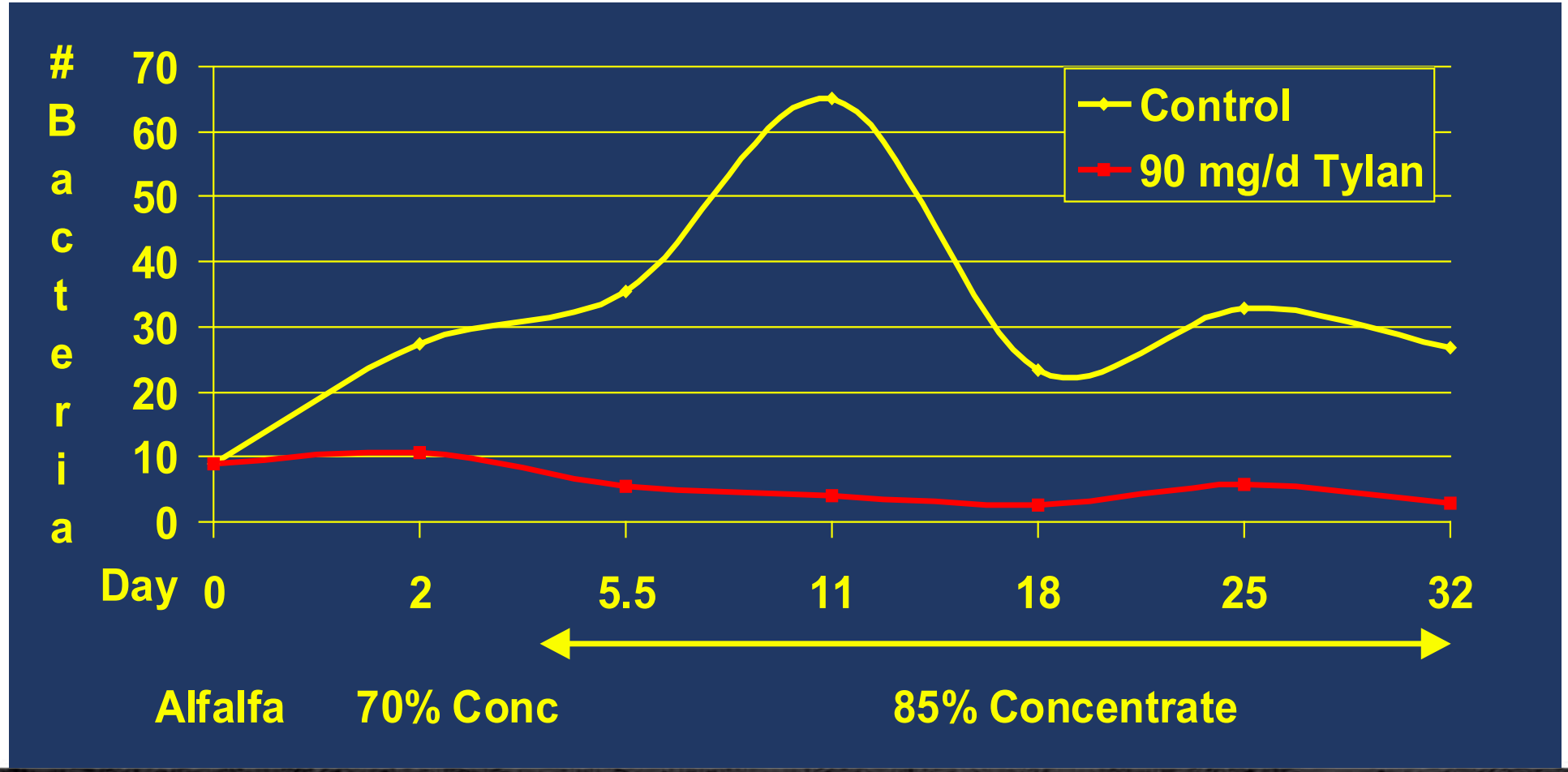


[a] Means differ, P < 0.05
[b]Means tend to differ, P < 0.10.

Elanco Animal Health. Data on file.

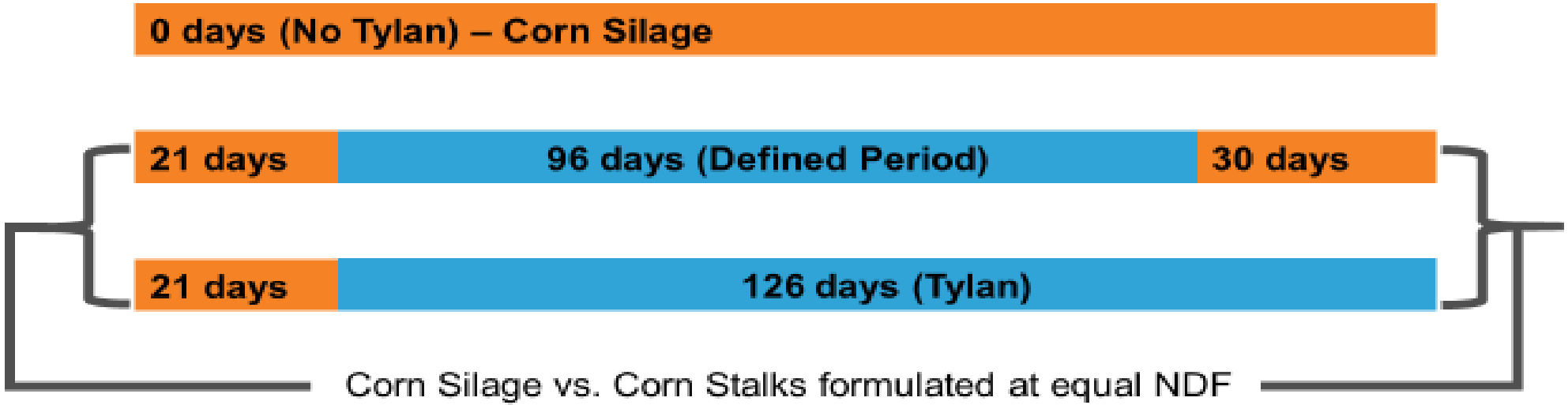
PM-US-19-0262

Effect of Tylan on F necrophorum in Rumen Contents, MPN 10^5 per ml



Nagaraja, et al, 1999. Tylan vs. control: P<.01 for all non-zero days.

Effectiveness of Tylan feeding program and roughage source to control liver abscess condemnation in beef steers



8 replications/trt; 235 hd/pen; 1880 hd/trt;
Analyzed as a 2 × 2 + 1 factorial;

Elanco Animal Health. Data on file.

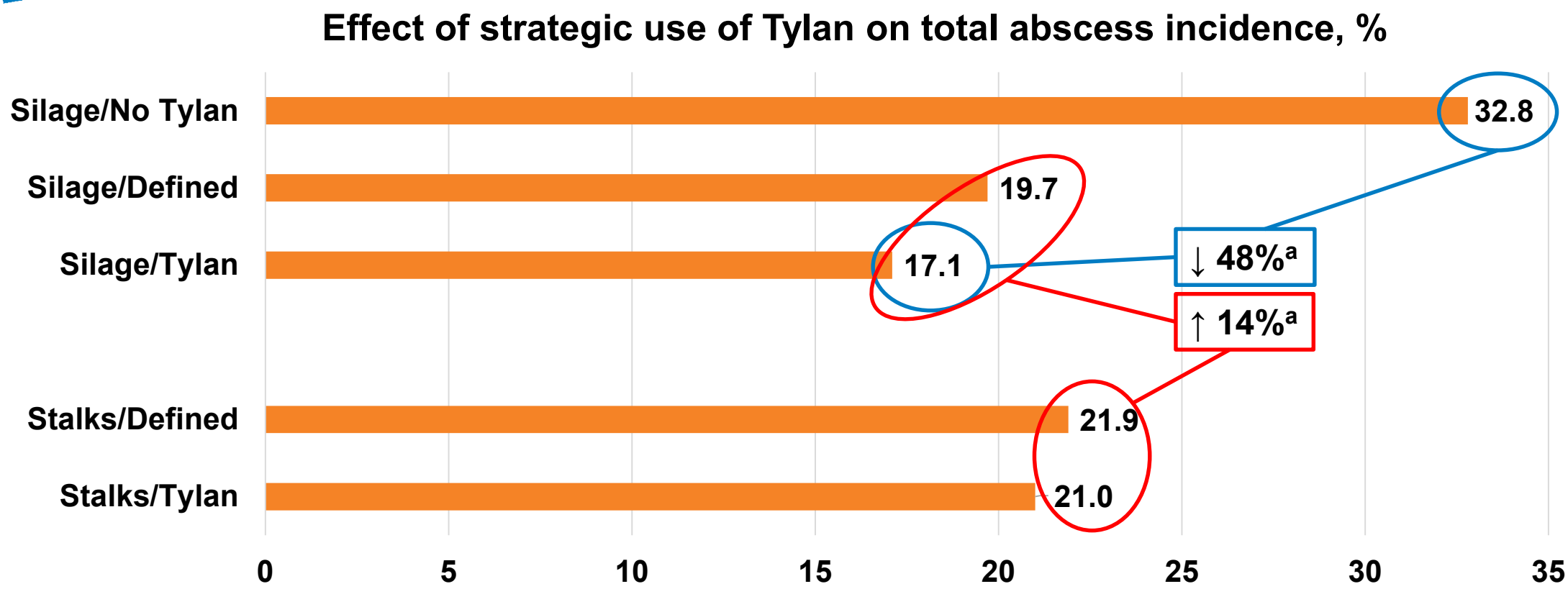
PM-US-19-0262

Ration Composition

Ingredient	Silage	Stalks
Steam-flaked corn	73.9	77.3
Corn silage	11.1	-
Corn stalks	-	7.2
Corn steep liquor	4.1	4.7
Corn steep liquor/urea	3.5	3.4
Tallow	5.0	5.1
Supplement	2.4	2.3

Elanco Animal Health. Data on file.

Liver abscess incidence



[a]Means differ, P < 0.05.

Elanco Animal Health. Data on file.

PM-US-19-0262

Effects of removing tylosin from diets with increasing roughage concentration on growth performance, carcass characteristics, and prevalence of liver abscesses of finishing cattle

- Crossbred steers, initial wt = 854 lb, 161 DOF
- Treatments:
  - 7.1 TYL: 7.1% corn stalks with tylosin
    - Tylan added when cattle were on ~65% Finisher (18 DOF)
  - 7.1 NT: 7.1% corn stalks without tylosin
  - 13.1 NT: 13.1% corn stalks without tylosin
  - 19.1 NT: 19.1% corn stalks without tylosin

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PM-US-19-0262

Ration Composition, % DM

Ingredient	7.1 TYL	7.1 NT	13.1 NT	19.1 NT
Steam-flaked corn	57.67	57.67	51.42	45.22
Corn distillers grain, wet	17.25	17.25	17.26	17.26
Sweet Bran Plus	17.02	17.02	17.04	17.04
Corn stalks	7.09	7.09	13.07	19.07
Fat, yellow grease	0.94	0.94	1.19	1.39
Micro ingredients	0.03	0.02	0.02	0.02

Elanco Animal Health. Data on file.

PM-US-19-0262

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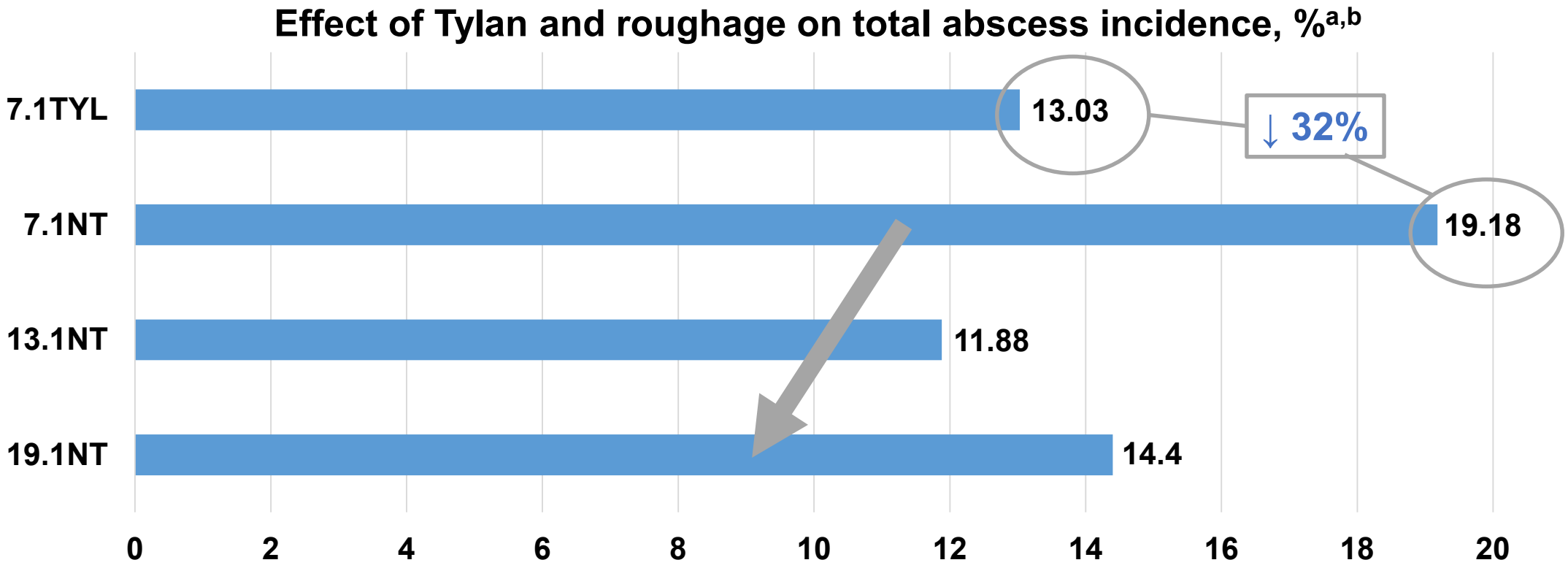
Liver abscess incidence



[a]7.1Yes vs 7.1No (P < 0.01).
[b]Linear effect of roughage among No Tylan, P < 0.01.

Elanco Animal Health. Data on file.

PM-US-19-0262

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Increasing Roughage Concentration

- Increasing roughage level 2x resulted in equal abscess control to antibiotic feeding
  - BUT intake increased 1 lb per day, feed efficiency became 5.1% poorer and HCW decreased 8 lb
- 3x forage resulted in 1.3 lb per day intake increase, 9.5% poorer feed efficiency and 23 lb less HCW

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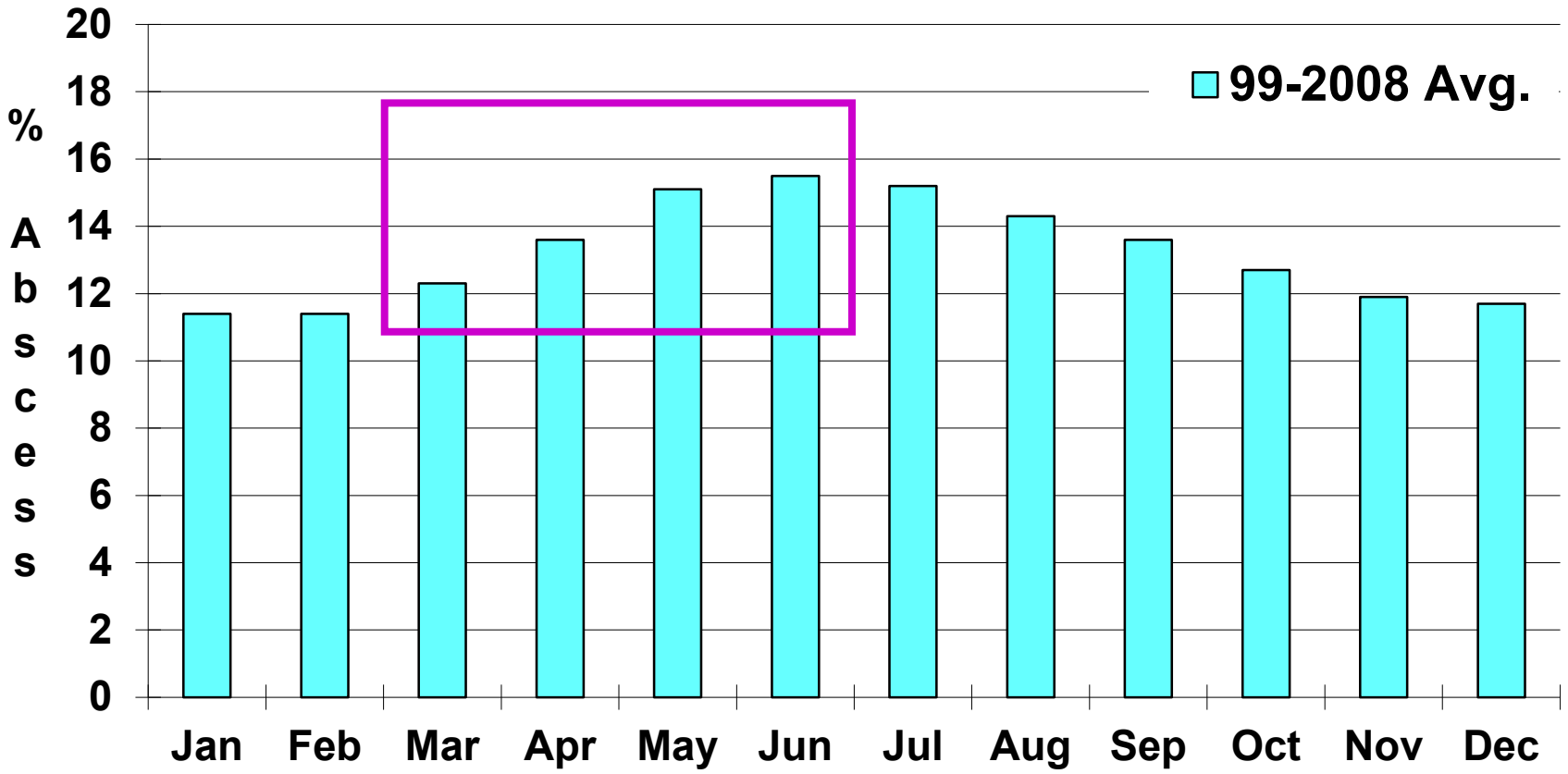
Weather, Cattle type, US location, Time of year

Total Abscesses by Month, Tylan-fed Steers



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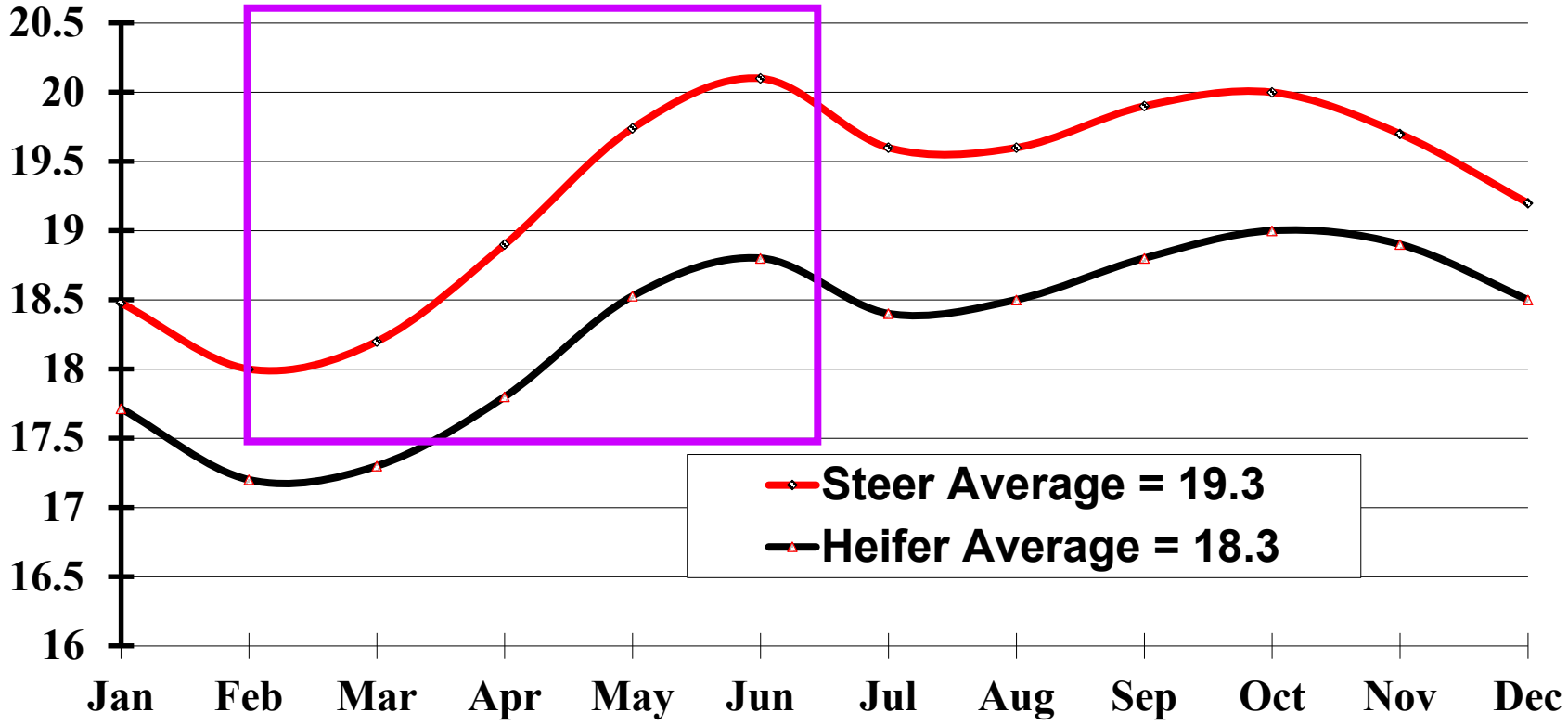
Monthly Average DMI, lb
January 1985 to December 2008



Monthly Photoperiod, hours per day Latitude 40° N

Feb	10:45
Mar	12:00
Apr	13:15
May	15:30
Jun	15:00

Source: Bos Technica Research Services

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Geographic Abscess Summary, 2010

Area	Sex	No. Lots	No. Head	% A	% A+	% Total	% Distoma
SW Kansas	Steer	2,506	304,473	8.8	6.0	14.8	2.9
TX Panhandle	Steer	1,878	280,629	7.1	4.0	11.1	6.1
Colorado	Steer	470	68,938	10.2	6.4	15.9	0.3
Nebraska	Steer	1,563	225,918	10.2	3.3	13.5	1.0
Desert SW	Steer	20	1,186	3.9	3.8	7.7	3.5
Pacific NW & ID	Steer	1,374	150,832	15.2	7.4	22.6	11.3

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Bunk Management

Control and Prevention Methods

- Approved feed-grade antibiotics
  - Chlortetracycline, Oxytetracycline, Tylosin and Virginiamycin
  - Tylan is the most widely used, +/-70% control
- Pro and pre-biotics, essential oil, zinc & proprietary products
  - S cerevisiae fermentation product: low and variable abscess control
- Vaccines: have been ineffective
  - KSU microbiologists identified protein allowing *F necrophorum to* attach to cells and colonizing the rumen wall. Research will determine the effectiveness

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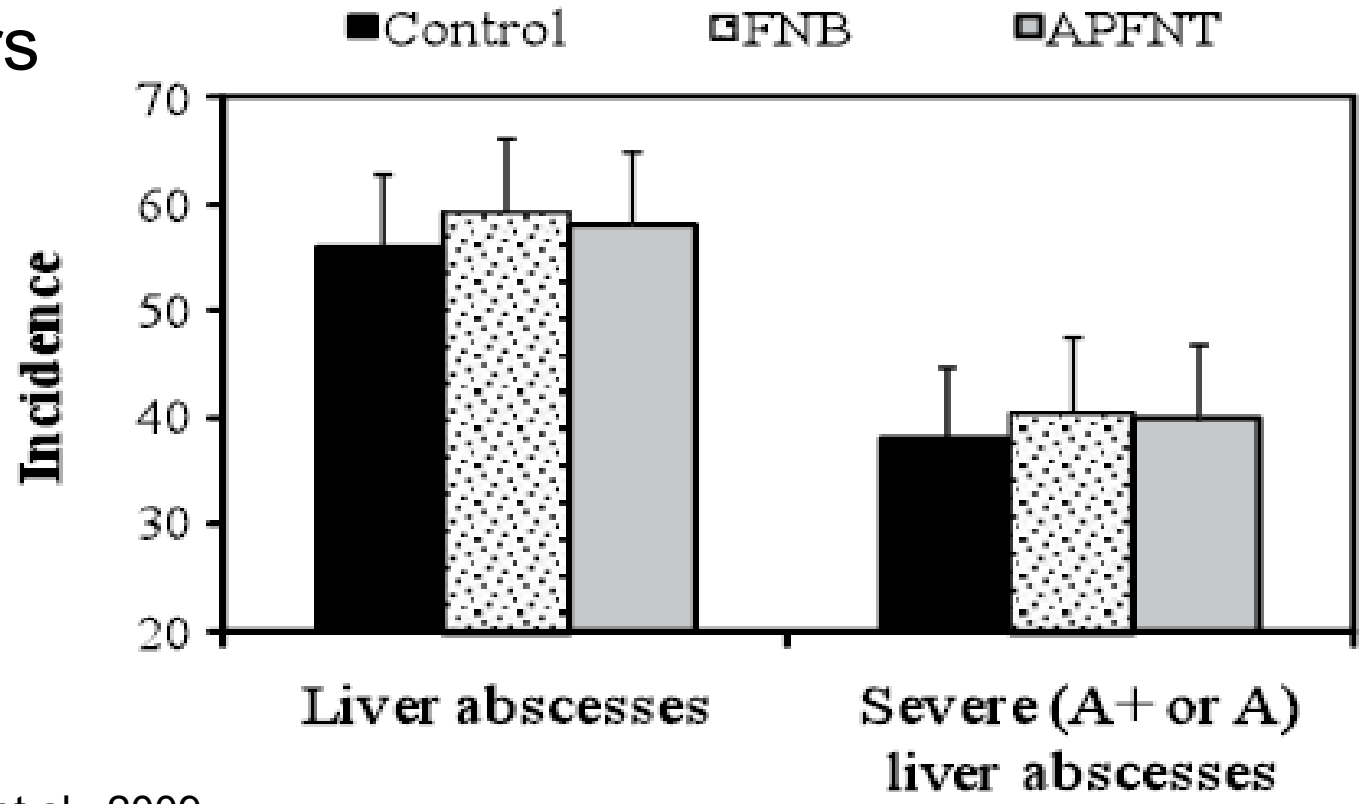
Vaccinated with Control, Fusogard® (FNB) or Centurion™ (APFNT)

- 1307 steers and heifers
- 613 lb initial weight
- 237 days on feed
- Vaccine per label
- No antibiotic



Fox et al., 2009

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Next Steps

- The multi-factorial causes of liver abscesses will likely avert absolute prevention or control from occurring any time soon
- New control measures should target:
  - *F necrophorum* control early in feeding period
  - Reduced lactic acid production
  - Enhanced lactic acid utilization
- "Outside the Box Thinking"
- Support those who support

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