


## Bone Alkaline Phosphatase as an indicator of phosphorus status in breeder cows

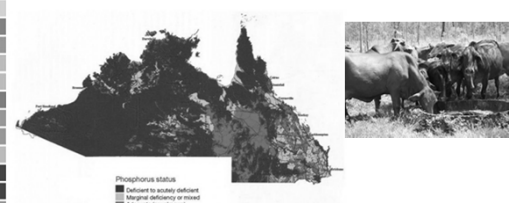
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## Phosphorus is a key challenge



In Northern Australia rangelands nutritional phosphorus deficiency is a major issue

## Guidelines to producers

Animals that need phosphorus the most are growing animals, late-pregnant breeders and wet cows

There are no simple diagnostic tests for the phosphorus status of cattle.


Blood phosphorus concentration is likely to give the best indication of the P status of a growing animal, but cannot be applied to a lactating cow.

<https://futurebeef.com.au>

## Our challenge

Better understand the physiological mechanisms controlling body Phosphorus reserves in beef breeder cows

Develop better diagnostic tests for P status



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## Using a bone marker for P status?

Bone specific Alkaline Phosphatase (BAP) is an enzyme synthesised solely by osteoblasts

Used as a biomarker for bone deposition.  
Role(s) in mineralisation.

However total Alkaline Phosphatase (ALP) is a more common standard biochemical test

ALP often used in conjunction with liver enzymes to provide differential diagnosis liver or bone disease

## Design & Methods

### Replenishment of P reserves post-weaning

Mature (6-11years) *Bos indicus* cross cows  
Pregnant, immediately post-weaning  
Housed in individual pens

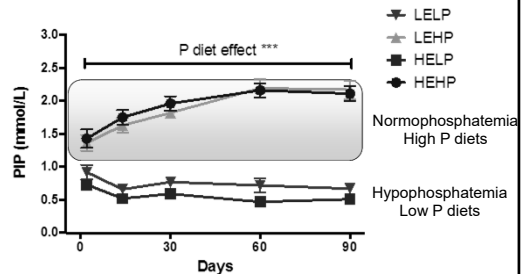
Fed ad-libitum P deficient diets for 13 weeks  
Either "low" (moderate) or "high" ME 8.6 vs 9.7 MJ/kg DM  
With "low" or "high" P 0.08 vs 0.28 g P/kg DM  
2x2 factorial design LE-LP, LE-HP, HE-LP, HE-HP groups

Measures: feed intake, digestibility, live weight  
Bone biopsies: start and end trial  
Blood samples: minerals, bone markers & hormones

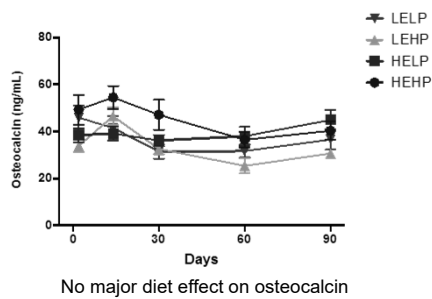
### Results:

Prior to start of experiment  
 PIP  $1.78 \pm 0.06$  mmol/L (n=40)  
 But range was 1.02 to 2.73 mmol/L  
*expectation of low to marginal P status*

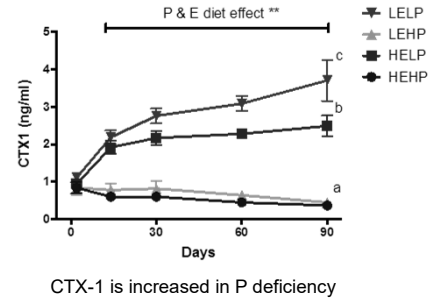
### Results: Phosphorus



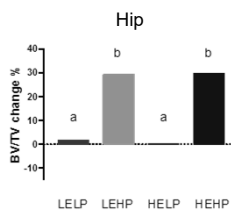
### Osteocalcin Bone Deposition Marker



### CTX-1 Bone Resorption Marker



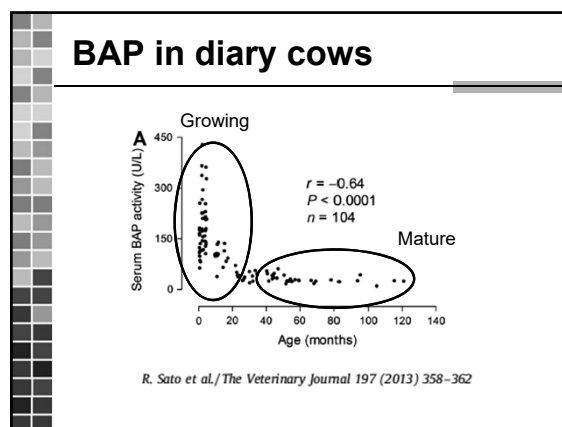
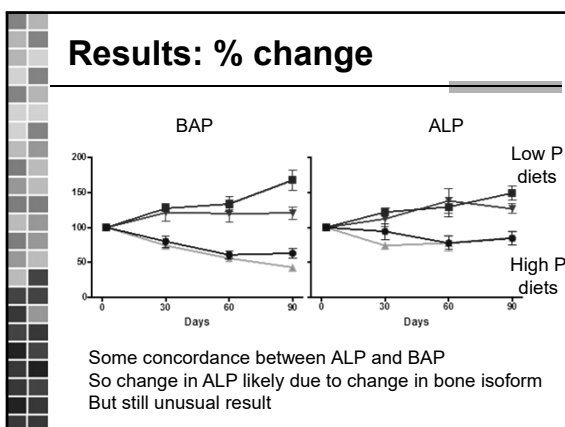
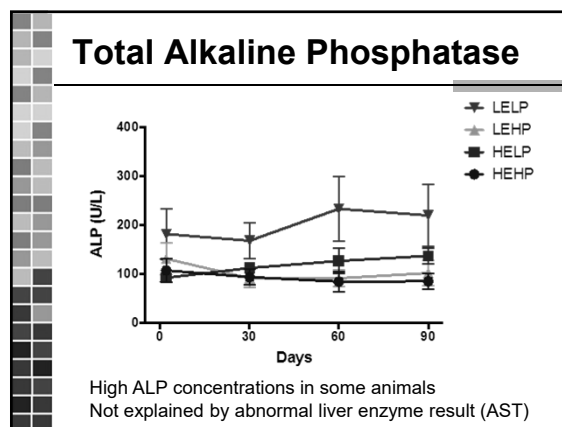
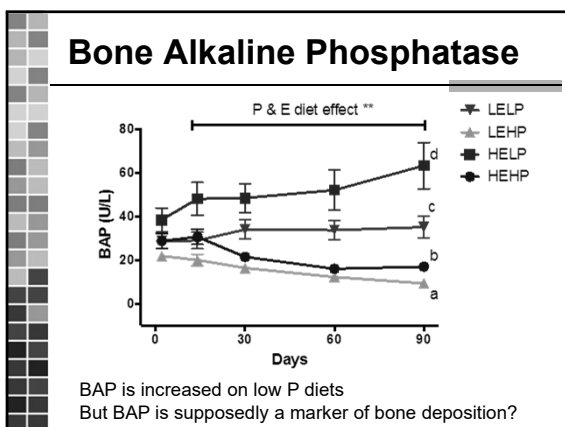
### Results: Bone biopsies



Additional diet P improved trabecular bone volume

### P Supplementation post-weaning mid-pregnancy

Increased plasma inorganic P  
 No effect Osteocalcin (bone deposition marker)  
 Decreased CTX-1 (bone resorption marker)  
 ie. decreased bone turnover  
 Increased trabecular bone volume



### Conclusions

BAP may be a candidate marker for P status in mature cows

BAP exhibits an inverse relationship to dietary P intake/plasma phosphorus

Increased ALP is observed with hypophosphatemia in humans, and is associated with osteomalacia.

Breeder cows can replenish skeletal P reserves after weaning, with adequate P supplementation & moderate ME diets

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### Acknowledgements

**University of Queensland**  
David McNeill  
Lisa Kidd  
Rob Dixon  
Mary Fletcher

**DAF Brian Pastures Research Station**  
Kerri Goodwin  
Don Cherry  
Bob Karfs

**Post-docs**  
Yuri Castells  
Jereme Spiers  
Marcelo Benvenuti

**DAF Biosecurity Sciences Laboratory**  
Brian Burren  
Michael Gravel

**Students**  
Keanne Santos  
Sam Van de Wakker  
Gabrielle Penna

Queensland Government

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