Feed additives to improve beef quality in Korean native beef cattle (韓牛, Hanwoo)

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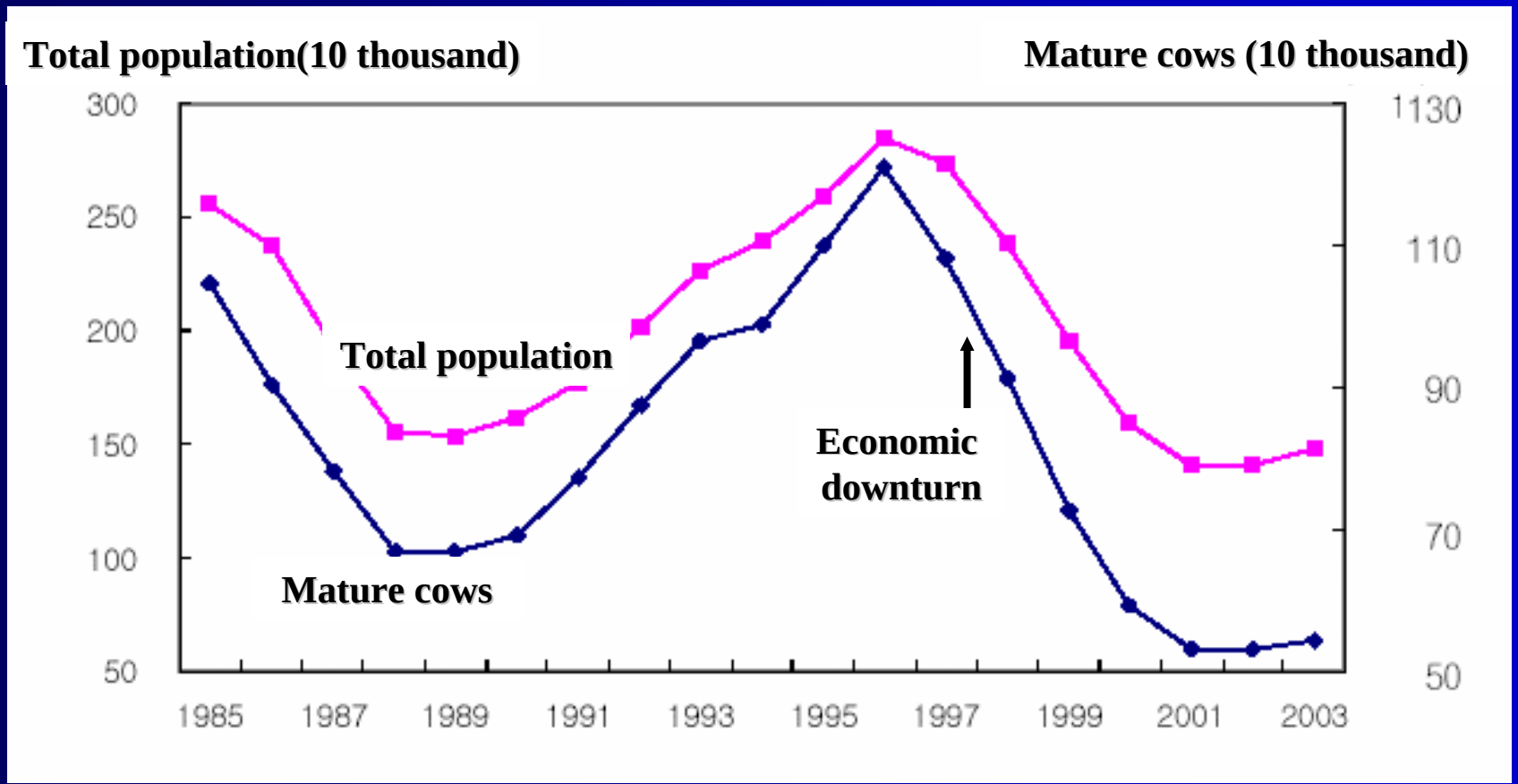
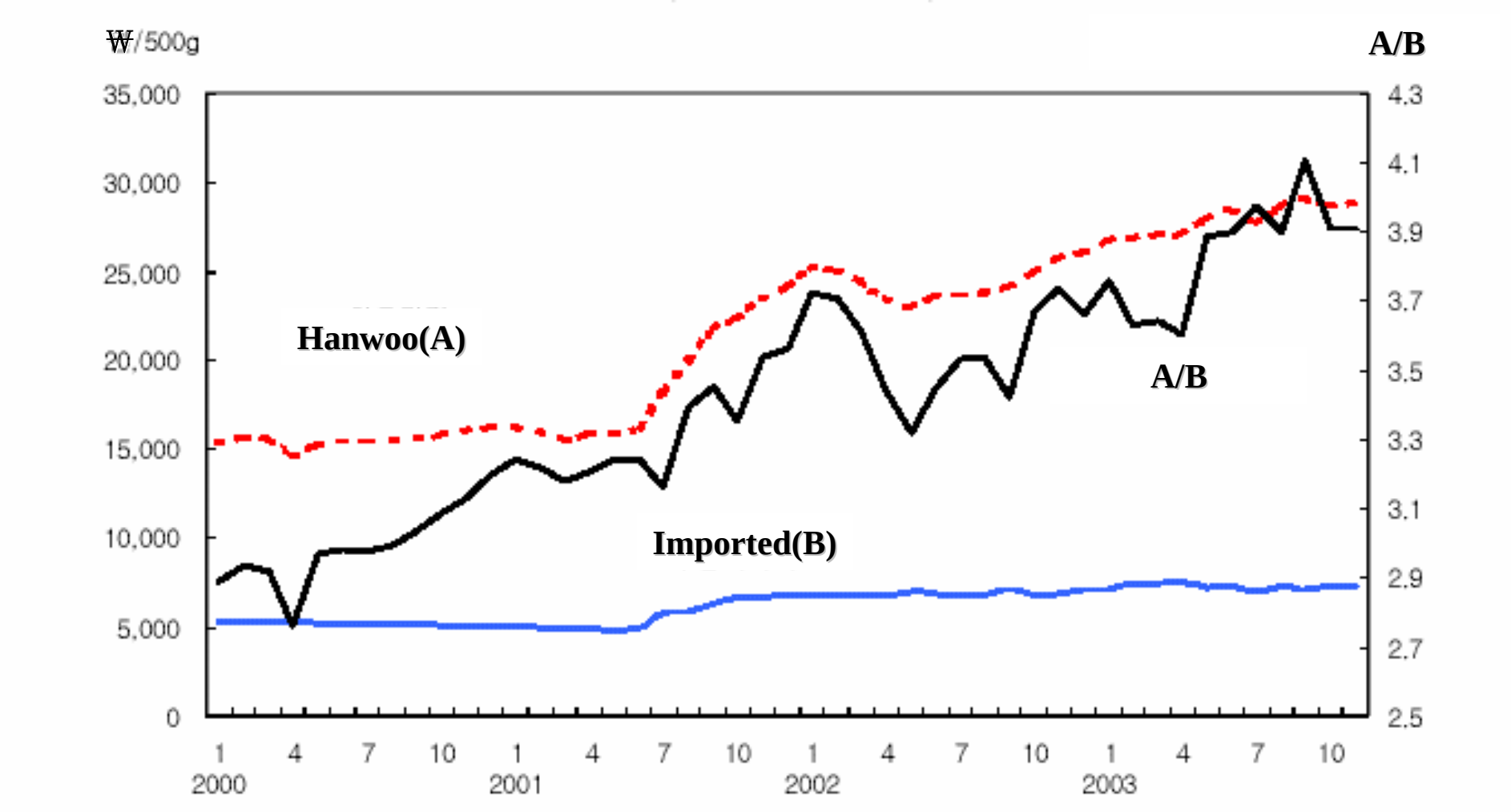
Introduction

- decrease in self-sufficiency : 52.8 %(2000) → 36.6%(2002)



(KREI, 2004)

Comparison of market price between Hanwoo and imported beef



- **Hanwoo beef is less competitive in price**

(KREI, 2004)

Hanwoo beef price by quality grade

Grade	Price(Won/kg carcass)	Relative Value
1+	15,916 (US$13.3)	100
1	15,285 (US$ 12.7)	96
2	11,035 (US$ 9.2)	69
3	9,706 (US$ 8.1)	61

(APGS, March 2004)

- **Much efforts has been made to produce high quality beef from Hanwoo**

Korean beef carcass grading standard

YIELD SCORE :
YIELD OF TRIMMED AND BONELESS WHOLESALE CUTS

A **B** **C**

MEAT QUALITY SCORE

1+ **1** **2** **3**

DAMAGE INDICATION

CONFORMATION

- Carcass weight
- Back fat thickness
- Longissimus area

MEAT QUALITY

- **Marbling score**
- Color and Brightness of Meat
- Firmness and Texture of Meat
- Color, Luster and Quality of Fat

MINIMUM SIDE WEIGHT

Feed additives to improve beef quality

Hanwoo steer (30month)

- ***Rumen-protected glucose to improve marbling score***
- ***Dietary vitamins and minerals to improve beef color***
- ***Se-enriched mushroom compost to fortify Se in beef***

Rumen-protected glucose

Incorporation of acetate and glucose into adipose tissues

- No significant site effect in glucose incorporation
- It means intramuscular adipose tissue used glucose more selectively than acetate

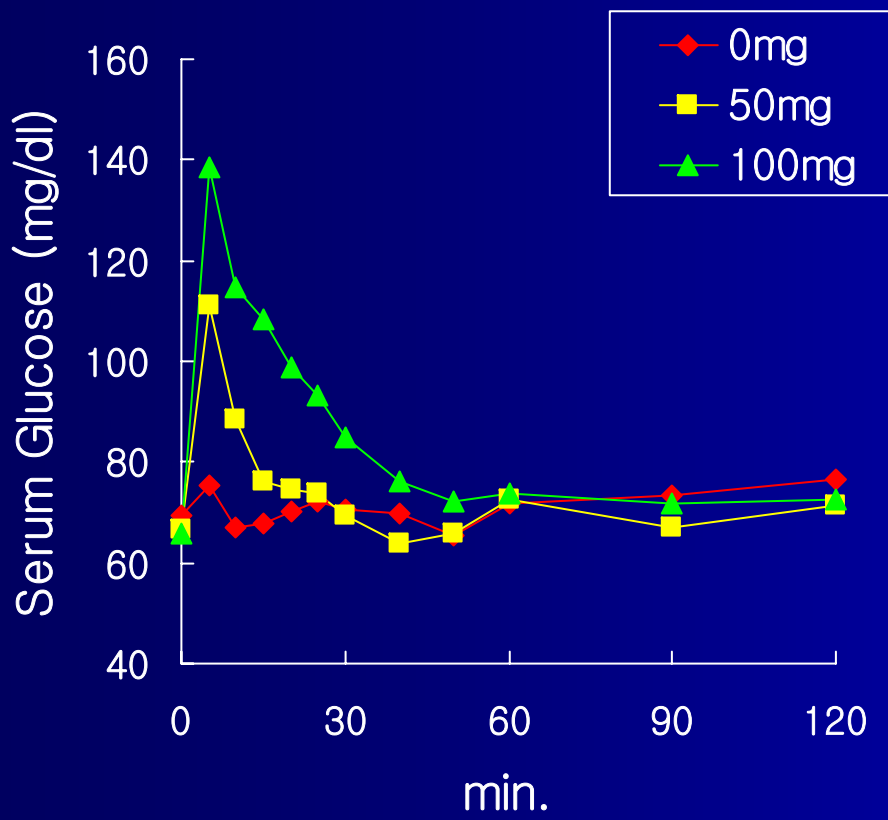
(nmol/3h/10^6 cells)

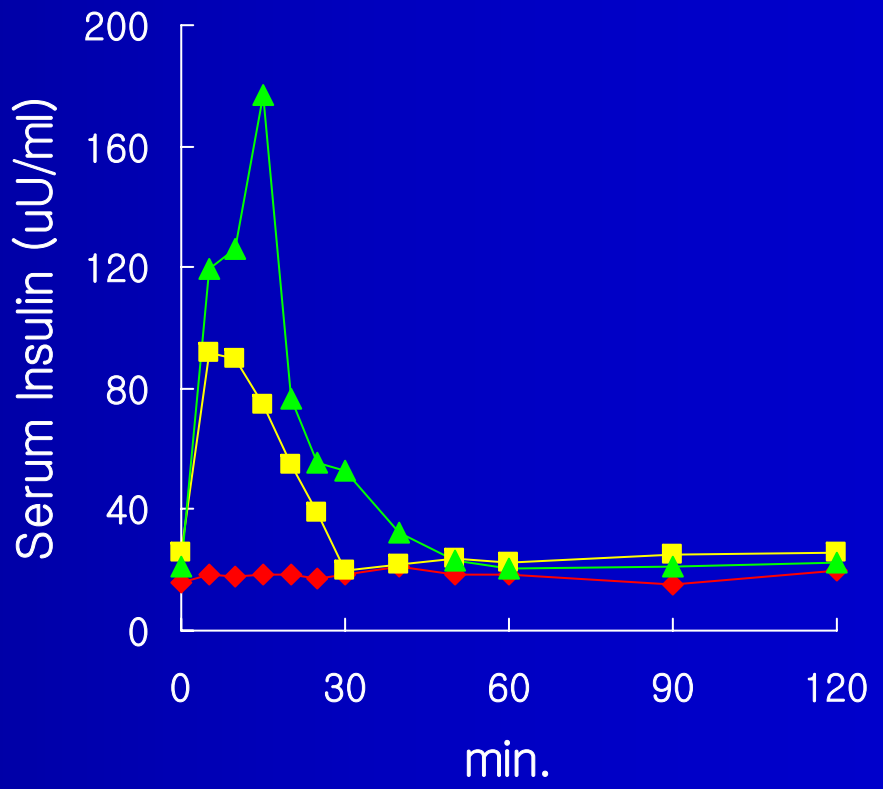
Site	[U-^{14}C] isotopes	
	Acetate	Glucose
Subcutaneous	2423.3[a]	1502.0[b]
Intramuscular	1703.7	1318.0
Site effect	*	NS

(Lee et al., 2000)

Serum profile by intravenous glucose infusion

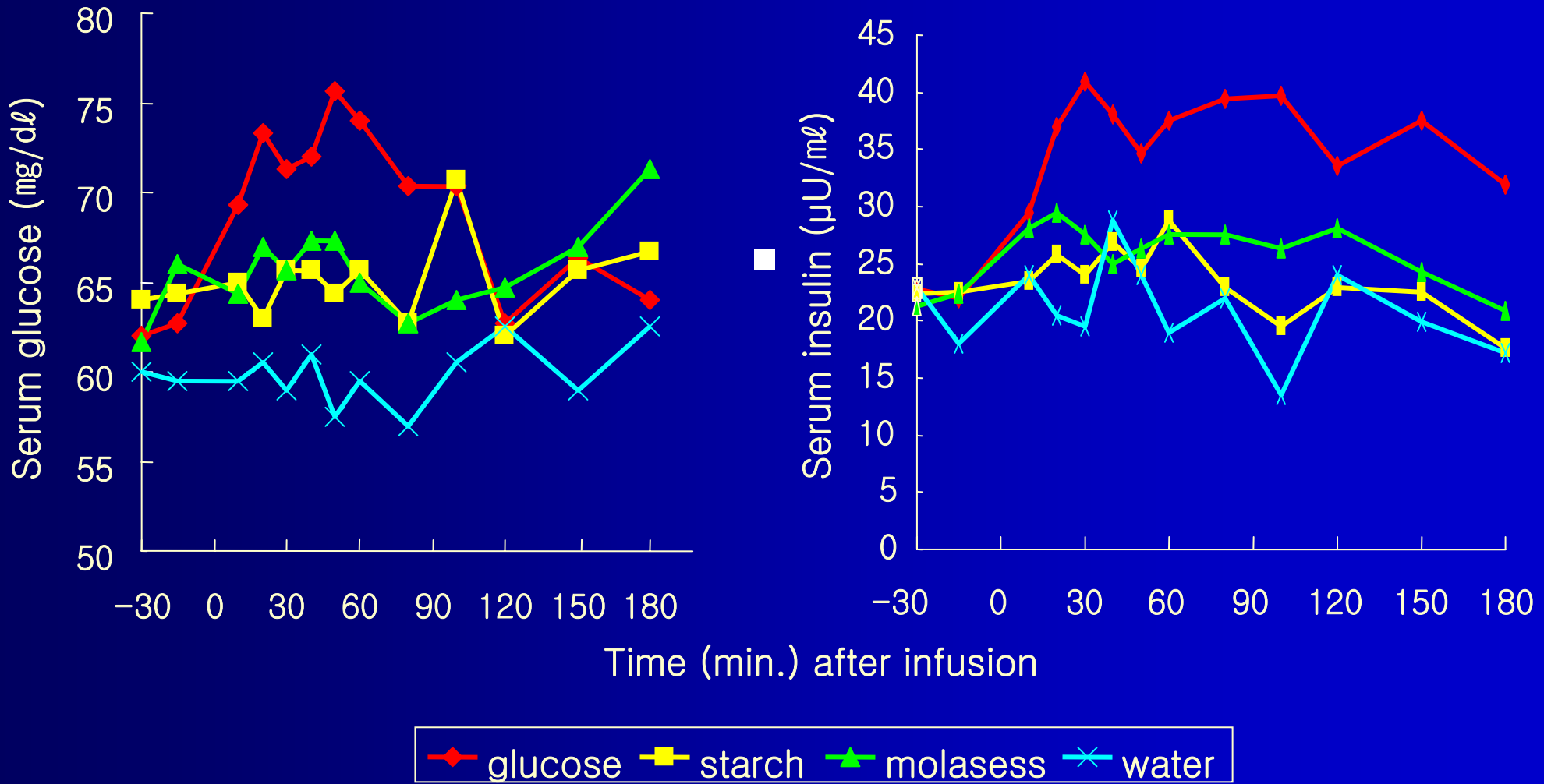
- Dose-dependant response of serum glucose and insulin as infusion level increased



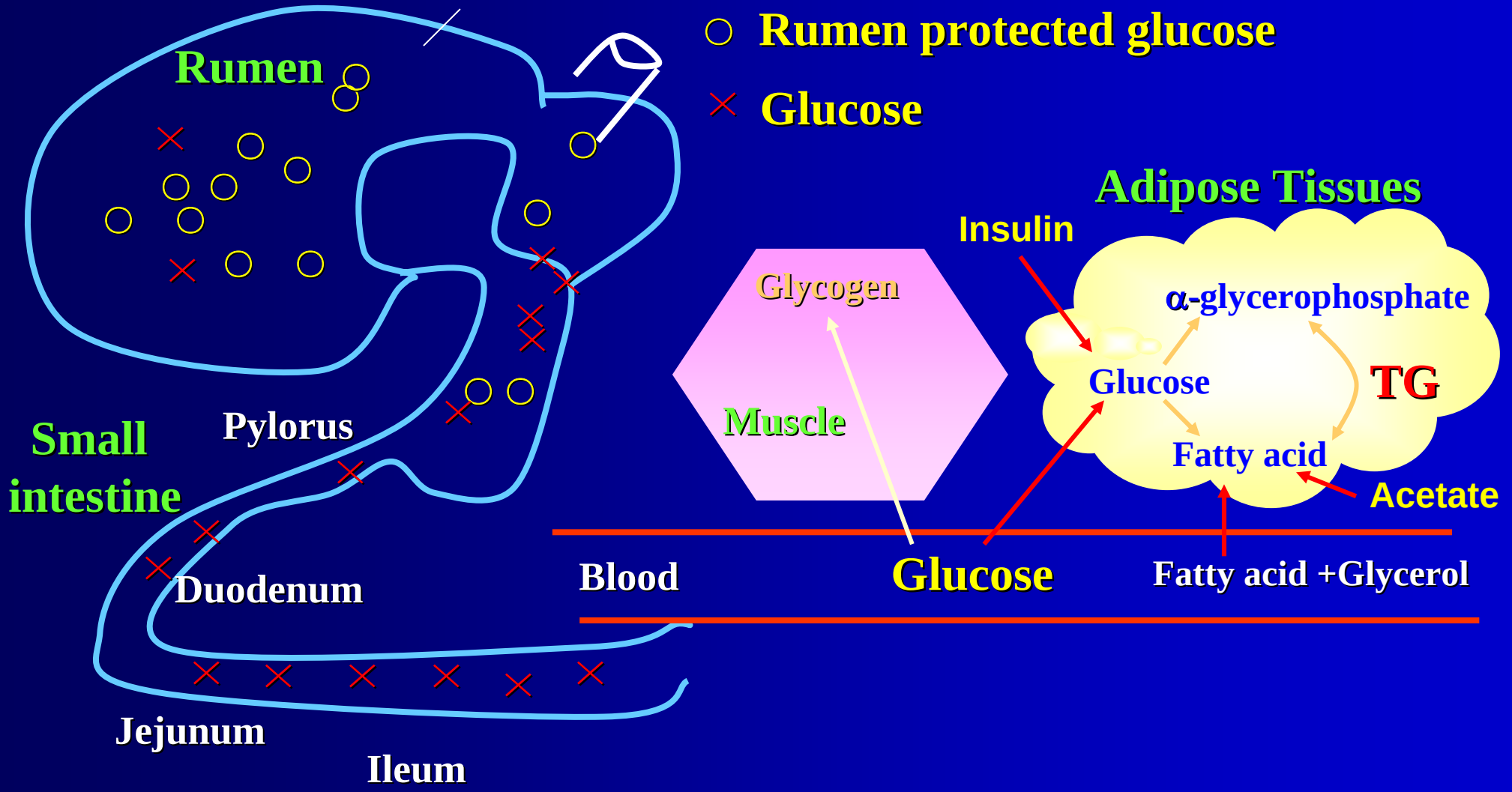


Serum profile by abomasal carbohydrate infusion

- Abomasal glucose infusion stimulated serum glucose and insulin levels

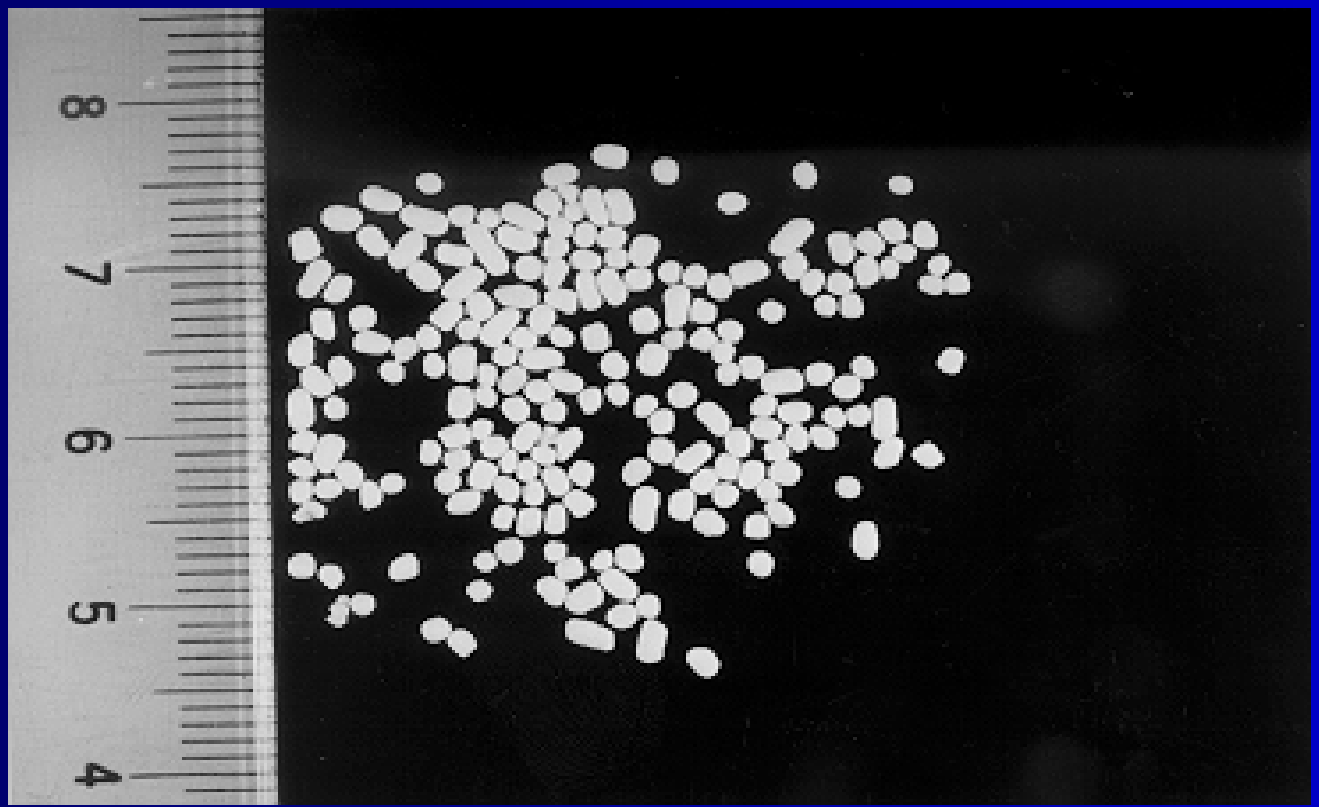


The effect of rumen-protected glucose on fat biosynthesis in adipose tissue of Hanwoo



Rumen-protected glucose bead as a feed additive

- **Coating material : Ethylcellulose, polymethacrylate(PMA)**
- **Different combination levels**
- **99% of bead was prepared as 1-2mm in diameter**



SEM of Glucose bead and rumen protected glucose supplements(×50)

- **The surface and coating layer were even and smooth**

Glucose bead

Glucose coated with ethylcellulose

Glucose coated with ethylcellulose and polymethacrylate

Bypass rates of ruminally protected glucose in digestive tracts by in sacco nylon bag technique

- Bypass rates of glucose supplements in gastrointestinal tracts were examined in sacco nylon bag techniques

- A and B passed through the rumen and abomasum more effectively than EXT and were degraded in the intestine.

Gastrointestinal digestive tract	Rumen-protected glucose			Significance
	A	B	EXT	
Rumen	81^{a}	69^{b}	70^{b}	*
Abomasum	68^{a}	48^{b}	0^{c}	*
Small intestine	37^{a}	34^{a}	0^{b}	*

Effect of ruminally protected glucose on sheep performances

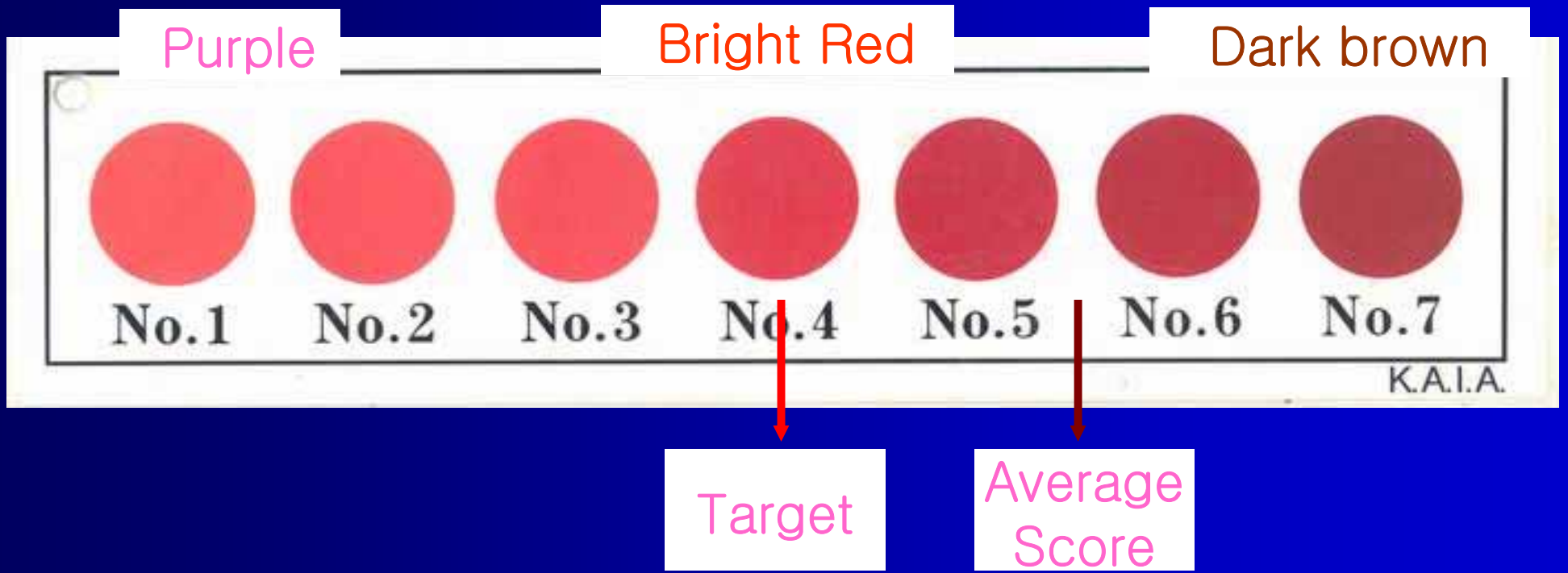
- 5% bypass glucose was supplemented in sheep diet for 3 month
- Marbling score was improved without increment of back fat thickness

Animal performances		Rumen-protected glucose			Significance
		A	B	EXT	
Initial weight(kg)	43.4	44.2	44.3	43.7	NS
Final weight(kg)	57.8	60.7	62.4	61.9	NS
Feed intake per weight gains(kg)	9.94	8.48	8.09	8.13	NS
Back fat thickness(cm)	1.18	1.00	1.05	1.38	NS
Marbling score	3.50	3.75	4.50	3.5	NS
Crude fat in loin(% DM)	13.77	15.07	11.96	14.63	NS

Dietary vitamins and minerals on stress hormone and beef color

Improvement of beef color by nutritional management

- Hanwoo beef is characterized more dark color, usually above 5 score according to Korea grading standard. But Korea consumer generally prefer score 4, which is bright red color.
- Many evidence shows beef color can be affected by bad management within 1-2days before slaughter



Objectives

- ✓ **To test effects of feeding ruminally protected individual minerals and vitamins on stress hormone levels in Hanwoo steers**
- ✓ **To test effects of a ruminally protected mixture of minerals and vitamins on beef color in Hanwoo steers**

Materials and Methods

Experiment I

- **Animals : Ten 29 month-old Hanwoo steers**
- **Design : Double 5x5 Latin Square**
- **Treatments**

Treatments	Dietary supplements
Control	100g Glucose
VC	Control + 10g Vitamin C
VB	Control + 13.52g Vitamin B mix
MG	Control + 25g MgO
CR	Control + 1.5g CrP

● Preparation of Dietary supplements

Bead Maker

Mixing

Pin Roller

Bead Making and Drying

Bead Coating

Finished Product

Experimental procedures

✓ **Supplemental mixtures** were fed to the animals twice a day, 200g a day, for two days prior to inducing transportation stress.

✓ **Transport Stress :** The animals were transported on a truck for 3 hours.

✓ **Blood sampling :** Blood samples (15ml each) were collected from a jugular vein just before and after inducing the stress

✓ **Analysis :** Plasma cortisol concentrations were analyzed using a commercial RIA kit (Coat-A-Count, DPC Inc).

Results

Experiment I

Table 1. Changes in plasma cortisol levels before and after inducing transport stress in response to dietary minerals and vitamins in finishing Hanwoo steers.

Index	Plasma Cortisol (μg/dL)				
	Control	VC■	VB	MgO	CrP
Before Stress	1.33	1.28	1.49	1.08	1.17
After Stress	7.19^{a}	6.08^{b}	5.79^{b}	6.09^{b}	5.70^{b}
Difference	5.86^{a}	4.80^{b}	4.30^{b}	5.00^{ab}	4.54^{b}

^{aa,b} Means within rows with different superscripts differ (P<0.05)

Experiment II

- **Animals : Ten 29 month-old Hanwoo steers**
- **Treatments**

Treatments	Dietary supplements
Control	No supplements
Treatment	Control + Vit.C + Vit.B + MgO + CrP

- **Design : Randomized block**
- **Experimental procedures : Same as in Experiment I**

  but slaughtered immediately after the transportation stress
- **Analysis : Carcass grades, beef color indices**

Results

Experiment II

Table 3. Carcass quality analyses in Hanwoo steers fed or not fed a ruminally protected mixture of minerals and vitamins.

Treatments	Beef color index	Fat color index	Body weight loss during transport (kg)	Hunter Value		
				L	a	b
Control	5.2	3.0	12.8	29.3	17.8	6.6
Treatment	4.4 *	3.0	11.0	31.2*	15.8	6.1

[A]* **P<0.05**

It should be possible to decrease stress responses of beef cattle and improve beef color by means of dietary inclusions of minerals and vitamins.

On-farm trial results

Table 4. Carcass quality analyses in Hanwoo steers fed or not fed a ruminally protected mixture of minerals and vitamins.

Treatments	Farm	No. of Animals	Carcass Weight (kg)	Back-fat Thickness (cm)	Rib Eye Area (cm^2)	Marbling Score	Beef Color Index
Control	A	30	335.1	8.5	80.9	2.9	4.87
	B	34	376.0	10.8	81.1	4.3	4.93
	Mean		356.8	9.8	81.0	3.7	4.90
Treatment	A	30	345.6	7.7	83.3	3.1	4.77
	B	47	365.3	11.4	80.1	4.3	4.72
	Mean		356.6	9.6	81.7	3.8	4.75

Table 5. Beef color indices in Hanwoo steers fed or not fed a ruminally protected mixture of minerals and vitamins.

Treatments	CIE Value		
	L	a	b
Control	38.4	19.8	6.6
Treatment	39.1	20.4	7.8

Conclusion

- ✓ **In Experiment 1, plasma cortisol levels were increased after the transport stress ($P<0.05$).**
- ✓ **Plasma cortisol level of animals in the treatments were lower after the stress compared with that of Control group ($P<0.05$).**
- ✓ **The inhibition of the increasing cortisol levels by dietary minerals and vitamins in Experiment 1 indicates reduction in responsiveness of the animals to the transport stress.**
- ✓ **In Experiment 2, beef color was improved by the dietary minerals and vitamins.**
- ✓ **Therefore, it is possible to decrease stress responses of beef cattle by means of dietary inclusions of minerals and vitamins.**

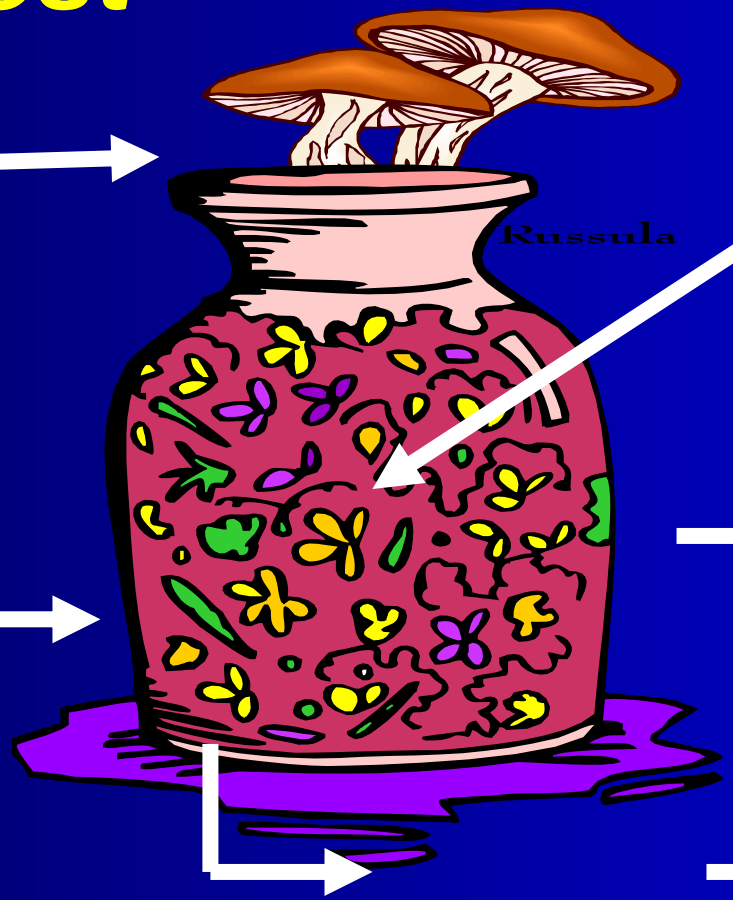
Selenium- fortified functional Hanwoo beef by utilizing Mushroom compost

Objectives

- ✓ **To investigate effects of spent composts of Se-enriched mushrooms as the dietary Se source on Se-fortified functional beef**

Se-enriched mushroom compost

Se-fortified mushroom harvest



Plenty of hyphae

Spent Compost

Inorganic Se
(selenite)
↓
Organic Se

Fermentation
(*Saccharomyces*, etc.)

Enrichment of organic Se

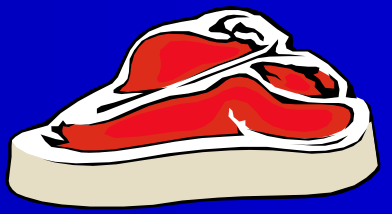
Control(0.1ppm)

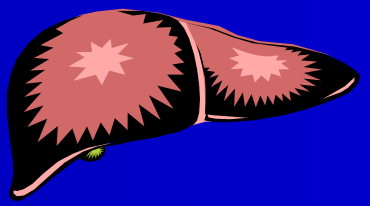
T1(0.3ppm)

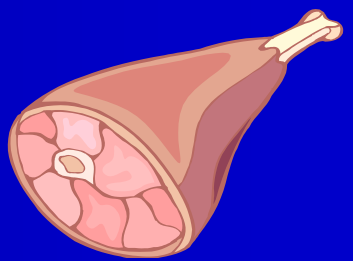
T2(0.6ppm)

T3(0.9ppm)

Fermented Spent Compost of mushroom





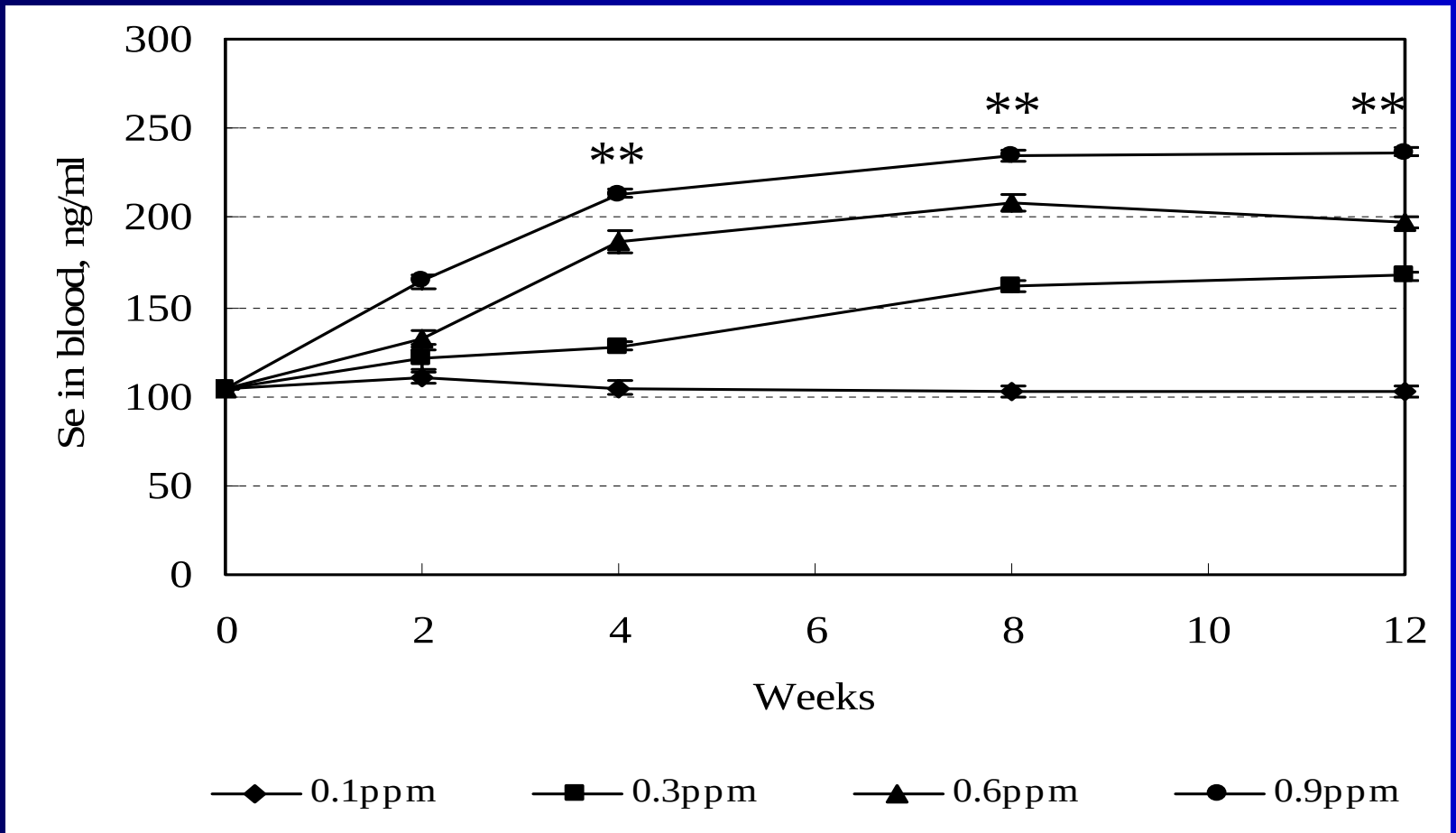


Initial BW:613kg

Feeding for 90 days

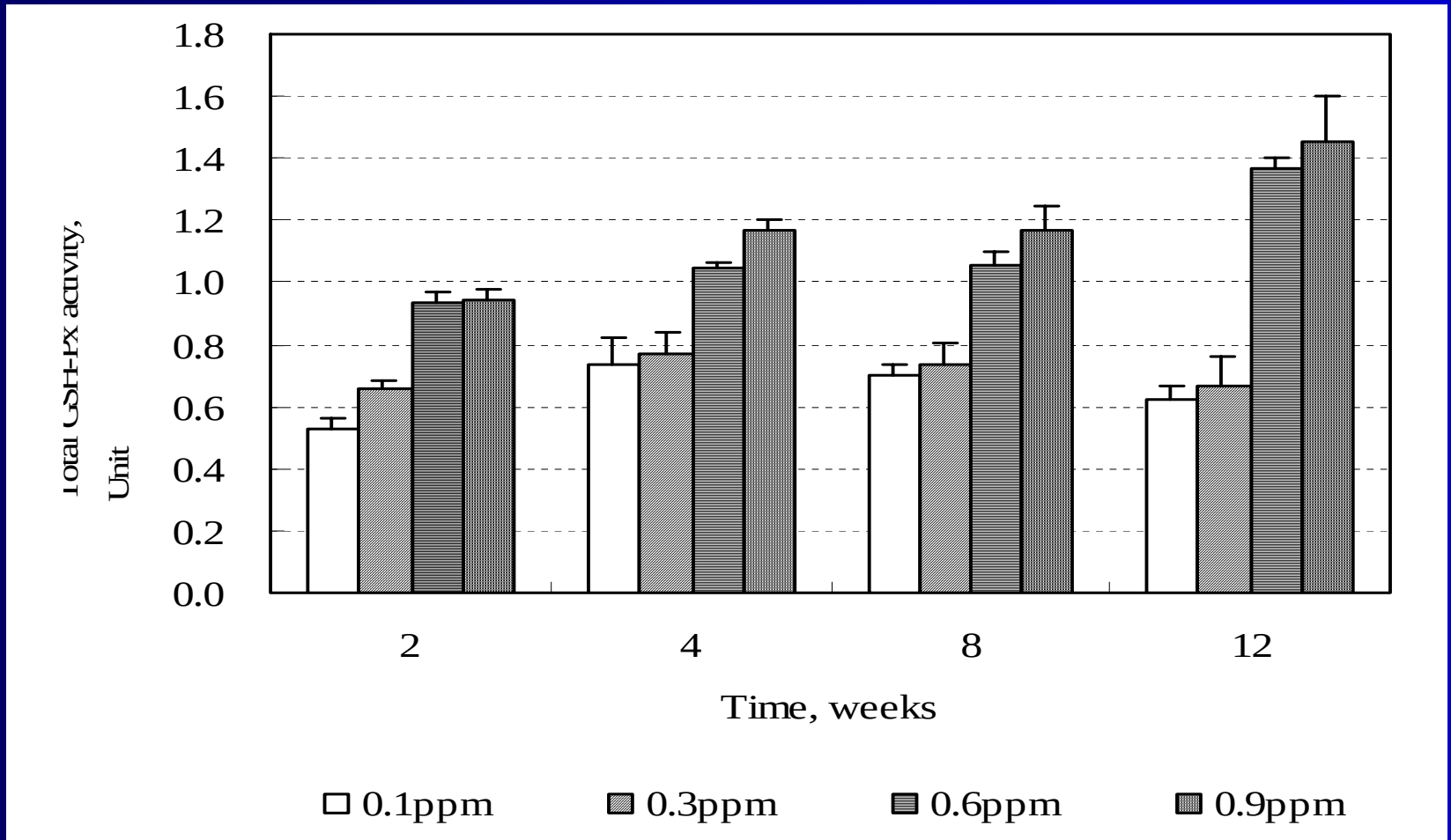
Change of whole blood selenium concentration

✓ **Se concentration in blood was linearly increased with increasing dietary Se levels**



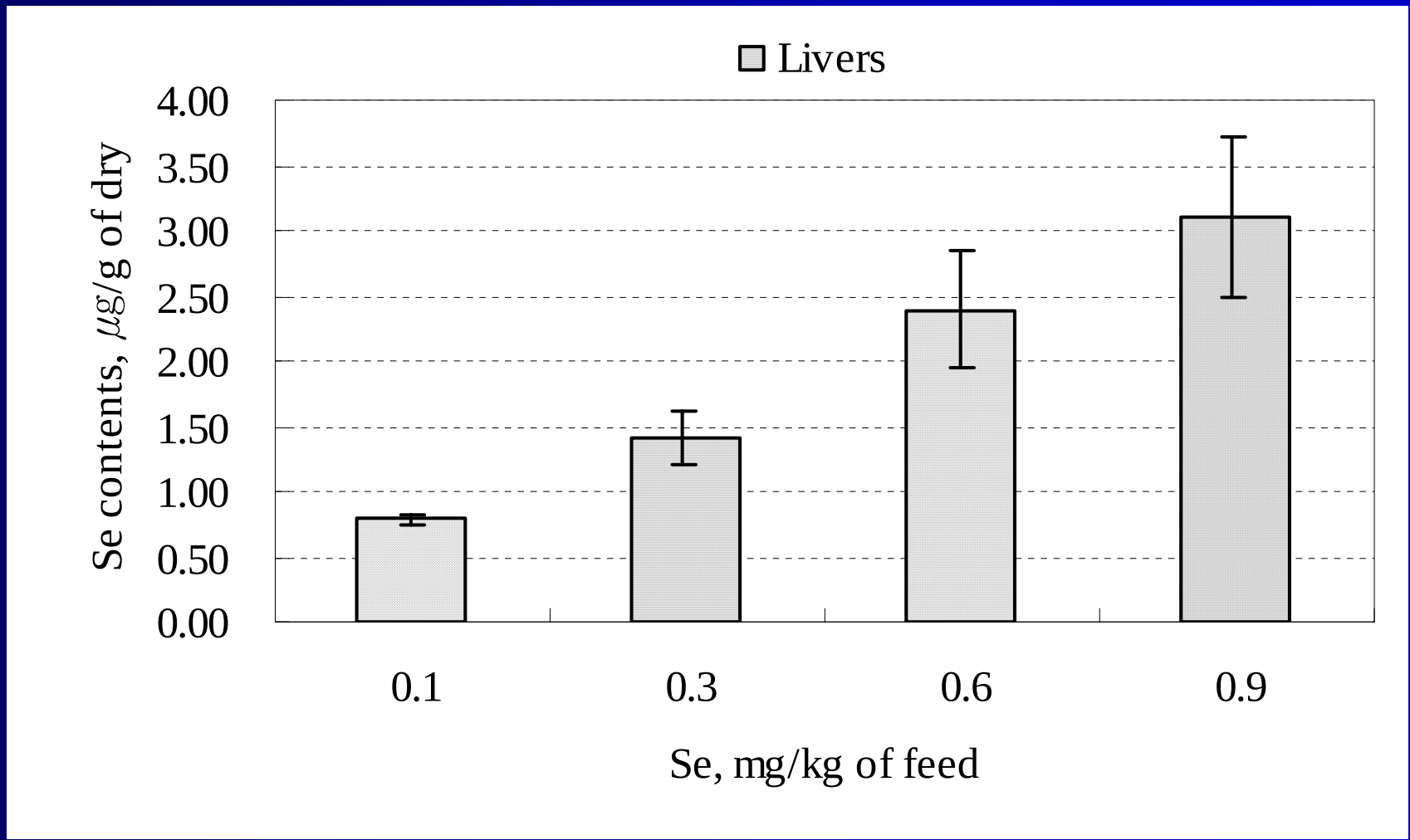
Total GSH-Px activities in blood plasma

✓ **The increased dietary Se level significantly increased plasma GSH-Px activities**



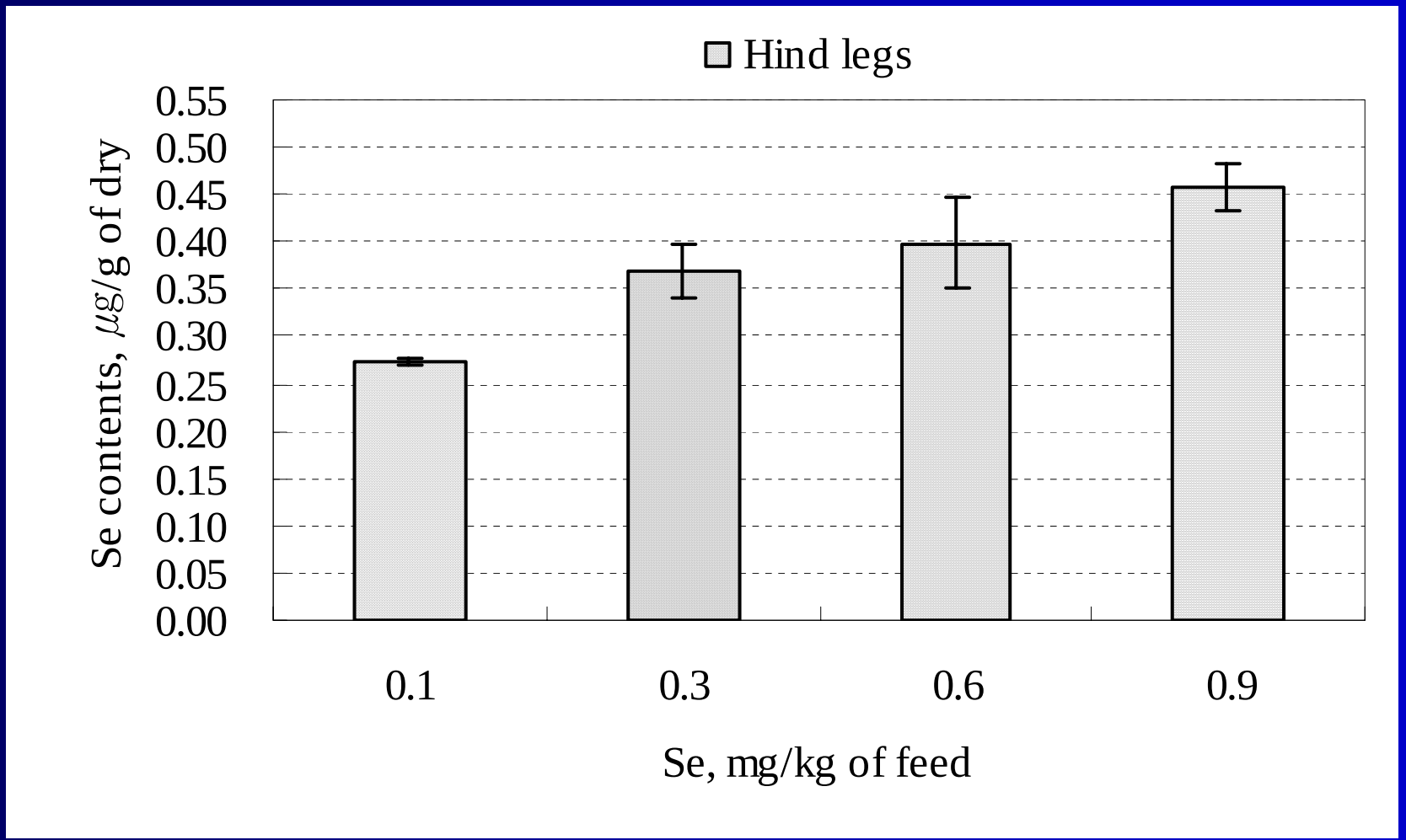
Selenium retention in livers

✓**Liver Se contents of Se-supplemented group were linearly increased up to 4 times compared with the control group**



Selenium retention in hind legs

✓**Muscle Se contents of Se-supplemented group were linearly increased by 1.4-1.7times compared with the control group**



Thank you very much