#### สารบาญ

	หน้า
กิตติกรรมประกาศ	ମ
บทคัดย่อภาษาไทย	4
บทคัดย่อภาษาอังกฤษ	น
สารบาญภาพ	ឦ
สารบาญตาราง	ฎ
สารบาญตารางภาคผนวก	<b>7</b>
อักษรย่อและสัญลักษณ์	น
บทที่ 1 บทนำ	1
วัตถุประสงค์ของการวิจัย	25
ประโยชน์ที่คาคว่าจะได้รับ	2
ขอบเขตและวิธีการวิจัย	2
บทที่ 2 ตรวจเอกสาร	3
การผลิตเนื้อลูกโคขุน	3
การใช้โปรตีนจากถั่วเหลืองทดแทนโปรตีนในอาหารแทนนม	4
สมรรถภาพการผลิตลูกโค	9
คุณภาพชากลูกโค	16
คุณภาพเนื้อลูกโค	21
คุณภาพไขมันในเนื้อลูกโค	31
บทที่ 3 อุปกรณ์และวิธีการ	34
อุปกรณ์และเครื่องมือ	34
Comรเคมีright by Chiang Mai Uni	V <sup>35</sup> / <sub>S</sub> itV
สัตว์ทดลอง	36
อาหารทดลอง	36
โรงเรือนทดลอง	37
การวางแผนการทดลอง	37

#### สารบาญ (ต่อ)

	หน้า
	ทนเ
การศึกษาด้านสมรรถภาพการผลิต	37
การศึกษาด้านคุณภาพซาก	38
การศึกษาด้านคุณภาพเนื้อ	41
การศึกษาคุณภาพไขมันในเนื้อ	48
การวิเคราะห์ทางสถิติ	51
สถานที่ทำการวิจัยและรวบรวมข้อมูล	51
บทที่ 4 ผลการทดลอง	52
บทที่ 5 วิจารณ์ผลการทดลอง	76
บทที่ 6 สรุปผลการทดลอง	92
เอกสารอ้างอิง	93
ภาคผนวกก	101
ตารางภาคผนวก	104
ประวัติผู้เขียน	132

#### สารบาญภาพ

Figu	re	หน้า
1	Proposed interaction between the feeding of iso-phosphoric	
	diets containing either casein or soya protein and the calcium	
	phosphate sediment in the lumen of small intestine. The increases	
	and decreases, as indicated by vertical arrow, highlight the difference	
	between the two feeding conditions.	8
2	Carcass length measurement	39
3	Loin eye area measurement	39
4	pH measurement at semimembranosus	41
5	Conductivity measurement at longissimus dorsi	42
6	Colour measurement of veal chops	44

#### สารบาญตาราง

Tabl	e	หน้า
1	Average daily feed intake (ADFI), average daily gain (ADG) and	
	protein efficiency ratio (PER) of calves fed different milk replacer	10
2	Feed intake, average daily gain (ADG), digesta flow rate, apparent	
	digestibility at the end of the ileum and N retention in calves fed	
	different milk replacers	lI
3	Carcass characteristics of calves fattened according to different	
	feeding schedules	19
4	Slaughter results and carcass assessment	20
5	Mean values (±SD) for pH values of longissimus lumborum muscles	
	(LL) measured at 45 min and 3, 24 and 48 h postmortem (PM) of	
	veal carcasses with a different rate of pH decline	
	(fast, intermediate and slow)	26
6	Mean values of sensory traits of longisimus lumborum and	
	semimembranosus by durations of feed withdrawal before	
	transport and transport duration	29
7	Sensory scores and shear values of veal roasts	30
8	Fatty acid (FA) composition (% of total FA) of longissimus muscle	32
9	Feed composition and chemical analysis of experiment diets	52
10	Total feed intake, average daily feed intake and weight gain of veal	gi A
	calves fed different diets	60
11	Average daily gain, feed conversion ratio and feed efficiency of veal calves fed	
	different diets	61
12	Cost of feeding of yeal calves fed different diets	62
13	The carcass quality of yeal calves fed different diets	64
14	External and internal organ of veal calves fed different diets	65
15	Theightle outing of yeal calves fed different diets	67

#### สารบาญตาราง (ต่อ)

		หน้า
16	The cutting of veal calves fed different diets in standard cutting	69
17	pH and conductivity values of veal calves at 45 min and 24 hour p.m. fed	
	different diets	70
18	Colour of veal calves chops	70
19	Water holding capacity of veal calves fed different diets	71
20	Chemical composition of veal chops	71
21	Panel scores and shear force values of veal chops of veal calves fed different diets	72
22	Composition of fatty acid of longissimus dorsi of veal calves fed different diet	74
23	TBA values, cholesterol and triglyceride content of meat of veal calves fed	
	different diets  UNIVERSAL	75

#### สารบาญตารางภาคผนวก

	หน้า
Appendix table 1: Analysis of variance of average daily feed intake of veal calves fed	
different diets on weeks 0-4 (adjusted)	104
Appendix table 2: Analysis of variance of average daily feed intake of veal calves fed	
different diets on weeks 4-8 (adjusted)	104
Appendix table 3: Analysis of variance of average daily feed intake of veal calves fed	
different diets on weeks 8-12 (adjusted)	104
Appendix table 4: Analysis of variance of average daily feed intake of veal calves fed	
different diets on weeks 12-16 (adjusted)	105
Appendix table 5: Analysis of variance of average daily feed intake of veal calves fed	
different diets on weeks 0-16 (adjusted)	105
Appendix table 6: Analysis of variance of total feed intake of veal calves fed different	
diets on weeks 0-4 (adjusted)	105
Appendix table 7: Analysis of variance of total feed intake of veal calves fed different	
diets on weeks 4-8 (adjusted)	105
Appendix table 8: Analysis of variance of total feed intake of veal calves fed different	
diets on weeks 8-12 (adjusted)	106
Appendix table 9: Analysis of variance of total feed intake of veal calves fed different	
diets on weeks 12-16 (adjusted)	106
Appendix table 10: Analysis of variance of total feed intake of veal calves fed different	
diets on weeks 0-16 (adjusted)	106
Appendix table 11: Analysis of variance of average daily gain of veal calves fed different	
diets on weeks 0-4 (adjusted)	106
Appendix table 12: Analysis of variance of average daily gain of veal calves fed different	
diets on weeks 4-8 (adjusted)	107
Appendix table 13: Analysis of variance of average daily gain of veal calves fed different	
diets on weeks 8-12 (adjusted)	107

	หน้า
Appendix table 14: Analysis of variance of average daily gain of veal calves fed	
different diets on weeks 12-16 (adjusted)	107
Appendix table 15: Analysis of variance of average daily gain of veal calves fed	
different diets on weeks 0-16 (adjusted)	107
Appendix table 16: Analysis of variance of feed conversion ratio of veal calves fed	
different diets on weeks 0-4 (adjusted)	108
Appendix table 17: Analysis of variance of feed conversion ratio of veal calves fed	
different diets on weeks 4-8 (adjusted)	108
Appendix table 18: Analysis of variance of feed conversion ratio of veal calves fed	
different diets on weeks 8-12 (adjusted)	108
Appendix table 19: Analysis of variance of feed conversion ratio of veal calves fed	
different diets on weeks 12-16 (adjusted)	108
Appendix table 20: Analysis of variance of feed conversion ratio of veal calves fed	
different diets on weeks 0-16 (adjusted)	109
Appendix table 21: Analysis of variance of feed efficiency of veal calves fed different	
diets on weeks 0-4 (adjusted)	109
Appendix table 22: Analysis of variance of feed efficiency of veal calves fed different	
diets on weeks 4-8 (adjusted)	109
Appendix table 23: Analysis of variance of feed efficiency of veal calves fed different	
diets on weeks 8-12 (adjusted)	109
Appendix table 24: Analysis of variance of feed efficiency of veal calves fed different	
diets on weeks 12-16 (adjusted)	110
Appendix table 25: Analysis of variance of feed efficiency of veal calves fed different	
diets on weeks 0-16 (adjusted)	110
Appendix table 26: Analysis of variance of weight gain of veal calves fed different diets	
on weeks 0-4 (adjusted)	110

	หน้า
Appendix table 27: Analysis of variance of weight gain of veal calves fed different diets	
on weeks 4-8 (adjusted)	110
Appendix table 28: Analysis of variance of weight gain of veal calves fed different diets	
on weeks 8-12 (adjusted)	111
Appendix table 29: Analysis of variance of weight gain of veal calves fed different diets	
on weeks 12-16 (adjusted)	111
Appendix table 30: Analysis of variance of weight gain of veal calves fed different diets	
on weeks 0-16 (adjusted)	111
Appendix table 31: Analysis of variance of slaughter weight of veal calves fed different	
diets (adjusted)	111
Appendix table 32: Analysis of variance of hot carcass weight of veal calves fed different	
diets (adjusted)	112
Appendix table 33: Analysis of variance of cold carcass weight of yeal calves fed different	
diets (adjusted)	112
Appendix table 34: Analysis of variance of dressing percentage of yeal calves fed different	;
diets (adjusted)	112
Appendix table 35: Analysis of variance of carcass length of veal calves fed different	
diets (adjusted)	112
Appendix table 36: Analysis of variance of loin eye area of veal calves fed different	
diets (adjusted)	113
Appendix table 37: Analysis of variance of head percentage of veal calves fed different	
diets (adjusted)	113
Appendix table 38: Analysis of variance of blood percentage of veal calves fed different	
diets (adjusted)	113
Appendix table 39: Analysis of variance of skin percentage of veal calves fed different	
diets (adjusted)	113

	หน้า
Appendix table 40: Analysis of variance of shank percentage of veal calves fed different	
diets (adjusted)	114
Appendix table 41: Analysis of variance of heart percentage of veal calves fed different	
diets (adjusted)	114
Appendix table 42: Analysis of variance of lung percentage of veal calves fed different	
diets (adjusted)	114
Appendix table 43: Analysis of variance of liver percentage of veal calves fed different	
diets (adjusted)	114
Appendix table 44: Analysis of variance of spleen percentage of veal calves fed different	
diets (adjusted)	115
Appendix table 45: Analysis of variance of stomach percentage of veal calves fed different	<i>!   </i>
diets (adjusted)	115
Appendix table 46: Analysis of variance of intestine percentage of veal calves fed different	
diets (adjusted)	115
Appendix table 46: Analysis of variance of kidney percentage of veal calves fed different	
diets (adjusted)	115
Appendix table 47: Analysis of variance of testis percentage of veal calves fed different	
diets (adjusted)	115
Appendix table 48: Analysis of variance of tail percentage of veal calves fed different	
diets (adjusted)	116
Appendix table 49: Analysis of variance of tough percentage of veal calves fed different	
diets (adjusted)	116
Appendix table 50: Analysis of variance of longissimus dorsi percentage of veal calves fed	
different diets in Thai style cutting (adjusted)	116
Appendix table 51: Analysis of variance of psoas major percentage of veal calves fed	
different diets in Thai style cutting (adjusted)	116

	หน้า
Appendix table 52: Analysis of variance of chuck percentage of veal calves fed different	
diets in Thai style cutting (adjusted)	117
Appendix table 53: Analysis of variance of neck percentage of veal calves fed different	
diets in Thai style cutting (adjusted)	117
Appendix table 54: Analysis of variance of brisket percentage of veal calves fed different	
diets in Thai style cutting (adjusted)	117
Appendix table 55: Analysis of variance of lump percentage of veal calves fed different	
diets in Thai style cutting (adjusted)	117
Appendix table 56: Analysis of variance of fore shank percentage of veal calves fed	
different diets in Thai style cutting (adjusted)	118
Appendix table 57: Analysis of variance of flank percentage of veal calves fed different	
diets in Thai style cutting (adjusted)	118
Appendix table 58: Analysis of variance of trim meat percentage of veal calves fed	
different diets in Thai style cutting (adjusted)	118
Appendix table 59: Analysis of variance of total lean meat percentage of veal calves fed	
different diets in Thai style cutting (adjusted)	118
Appendix table 60: Analysis of variance of fat percentage of veal calves fed different	
diets in Thai style cutting (adjusted)	119
Appendix table 61: Analysis of variance of bone percentage of veal calves fed different	
diets in Thai style cutting (adjusted)	119
Appendix table 62: Analysis of variance of muscle percentage of 12 <sup>th</sup> dissection of	
veal calves fed different diets in Thai style cutting (adjusted)	119
Appendix table 63: Analysis of variance of fat percentage of 12 <sup>th</sup> dissection of	
veal calves fed different diets in Thai style cutting (adjusted)	119
Appendix table 64: Analysis of variance of bone percentage of 12 <sup>th</sup> dissection of	
yeal calves fed different diets in Thai style cutting (adjusted)	120

	หน้า
Appendix table 65: Analysis of variance of short loin percentage of veal calves fed differen	ıt
diets in standard cutting (adjusted)	120
Appendix table 66: Analysis of variance of chuck percentage of veal calves fed different	
diets in standard cutting (adjusted)	120
Appendix table 67: Analysis of variance of rack percentage of veal calves fed different dies	ts
in standard cutting(adjusted)	120
Appendix table 68: Analysis of variance of long leg percentage of veal calves fed different	
diets in standard cutting(adjusted)	121
Appendix table 69: Analysis of variance of shank percentage of veal calves fed different	
diets in standard cutting (adjusted)	121
Appendix table 70: Analysis of variance of breast percentage of veal calves fed different	
diets in standard cutting (adjusted)	121
Appendix table 71: Analysis of variance of flank percentage of veal calves fed different	
diets in standard cutting (adjusted)	121
Appendix table 72: Analysis of variance of pH at 45 min of longissimus dorsi of veal	
fed different diets	122
Appendix table 73: Analysis of variance of pH at 24 h of longissimus dorsi of veal	
fed different diets	122
Appendix table 74: Analysis of variance of pH at 45 min of semimembranosus of veal	
fed different diets	122
Appendix table 75: Analysis of variance of pH at 24 h of semimembranosus of veal	
fed different diets	122
Appendix table 76: Analysis of variance of EC at 45 min of longissimus dorsi of loin	
of veal calves fed different diets	123
Appendix table 77: Analysis of variance of EC at 24 h of longissimus dorsi of loin	
of veal calves fed different diets	123

	หน้า
Appendix table 78: Analysis of variance of EC at 45 min of semimembranosus of loin	
of veal calves fed different diets	123
Appendix table 79: Analysis of variance of EC at 24 h of semimembranosus of loin	
of veal calves fed different diets	123
Appendix table 80: Analysis of variance of L* of loin of veal calves fed different diets	124
Appendix table 81: Analysis of variance of a* of loin of veal calves fed different diets	124
Appendix table 82: Analysis of variance of b* of loin of veal calves fed different diets	124
Appendix table 83: Analysis of variance of dry matter percentage of loin of veal calves fee	i 🏃
different diets	124
Appendix table 84: Analysis of variance of moisture percentage of loin of veal calves fed	
different diets	125
Appendix table 85: Analysis of variance of protein percentage of loin of veal calves fed	
different diets	125
Appendix table 86: Analysis of variance of fat percentage of loin of veal calves fed	
different diets	125
Appendix table 87: Analysis of variance of drip loss percentage of loin of yeal calves fed	
different diets	125
Appendix table 88: Analysis of variance of thawing loss percentage of loin of	
veal calves fed different diets	126
Appendix table 89: Analysis of variance of boiling loss percentage of loin of	
veal calves fed different diets	126
Appendix table 90: Analysis of variance of grilling loss percentage of loin of	
veal calves fed different diets	126
Appendix table 91: Analysis of variance of tenderness score of loin of veal calves fed	
different diets	126
Appendix table 92: Analysis of variance of flavour score of loin of veal calves fed	
different diets	127

	หน้า
Appendix table 93: Analysis of variance of juice score of loin of veal calves fed	
different diets	127
Appendix table 94: Analysis of variance of overall acceptability score of loin of	
veal calves fed different diets	127
Appendix table 95: Analysis of variance of instron (shear force) of loin of	
veal calves fed different die ts	127
Appendix table 96: Analysis of variance of cholesterol content of meat of veal calves fed	
different diets	128
Appendix table 97: Analysis of variance of TBA values of meat of veal calves fed	
different diets	128
Appendix table 98: Analysis of variance of triglyceride content of meat of veal calves fed	
different diets	128
Appendix table 99: Analysis of variance of myristic acid (C14:0) percentage of meat	//
of veal calves fed different diets	128
Appendix table 100: Analysis of variance of palmitic acid (C16:0) percentage of meat	
of veal calves fed different diets	129
Appendix table 101: Analysis of variance of palmitoleic acid (C16:1) percentage of meat	
of veal calves fed different diets	129
Appendix table 102: Analysis of variance of stearic acid (C18:0) percentage of meat	
of veal calves fed different diets	129
Appendix table 103: Analysis of variance of oleic acid (C18:1) percentage of meat	
of veal calves fed different diets	129
Appendix table 104: Analysis of variance of linoleic acid (C18:2) percentage of meat	
of veal calves fed different diets	130
Appendix table 105: Analysis of variance of linolenic acid (C18:3) percentage of meat	
of veal calves fed different diets	130

	หน้า
Appendix table 106: Analysis of variance of unsaturated to saturated fatty acid (FAR)	
of meat of veal calves fed different diets	130
Appendix table 107: Analysis of variance of ratio of stearic acid / linoleic acid of meat	
of veal calves fed different diets	130
Appendix table 108: Analysis of variance of ratio of polyenic acid to saturated	
fatty acid of meat of veal calves fed different diets	131
Appendix table 109: Analysis of variance of ratio calculate without considering	
stearic acid of meat of veal calves fed different diets	131
Appendix table 110: Analysis of variance of double bonds index= double bonds per	
100 fatty acids of meat of veal calves fed different diets	131
AI UNIVERSITA	70

#### อักษรย่อและสัญลักษณ์

a\* redness (red-green index)

ADG average daily gain

ADFI average daily feed intake

Adjust P/S ratio adjust polyunsaturated: saturated fatty acid (no stearic acid)

AOAC Association of Official Analytical Chemists

b\* yellowness (yellow-blue index)

BC barley concentrate

CRD completely random design

CP crude protein

CS whole shelled corn

DBI double bond index

DFD dark firm dry

DMI dry matter intake

DSM dried skim milk

EDTA Ethylenedinitrilotetraacetic acid disodium salt dehydrate

FA fatty acid

FCR feed conversion ratio

FI feed intake

FE feed efficiency

gram

g/d gram per day

GC gas chromatography

HSPI hydrolyzed soy protein isolate

HSF soy flour heated

kg kilogram

kg/d kilogram per day

LD longissimus dorsi

LL longissimus lumborum

LT longissimus thoracic

MR milk replacer

MS meat - soluble

MSC maize and concentrate

n.s. non significant
p.m postmortem

PSE pale soft and exudative

P/S ratio polyunsaturated: saturated fatty acid

PUFA polyunsaturated fatty acid

SAS statistic analysis system

SBP soybean protein

SEM standard error of the mean.

SF soy flour
SM skim milk

Sm semimembranosus

SMP milk replacer containing skim milk protein

SP milk replacer containing soy protein

SPAA SP plus amino acid supplementation

TD transport duration

TLF time since last feeding before transport to the abattoir

TDN total digestible nutrient

WHC water holding capacity

WPC whey protein concentrate