

SWINE NUTRITION A PRACTICAL APPROACH

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Swine Nutrition A Practical Approach

- 1. Nutrient specifications for swine and ration formulation**
- 2. Feeding management of swine in various life stages**
- 3. Feed manipulation to produce designer pork**
- 4. Prevention and treatment of nutritional disorders in swine**
- 5. Feed additives for Swine**



WATER

- ▶ **Growing pigs consume ~2–3 kg of water for every kg of dry feed.**
- ▶ **Lactating sows consume more water because of the high water content of the milk they produce.**
- ▶ **Water restriction reduces performance and milk production.**
- ▶ **May result in death if the restriction is severe.**



Nutrients

Water

Carbohydrates
Soluble
carbohydrates
and Crude fibre

Protein

Fat

Minerals

Vitamins

Carbohydrates, Protein and Fats contribute towards ENERGY

Nutrient specifications for swine and ration formulation

- **Nutrient specifications**
- **Ration formulation**





Swine Nutrition A Practical Approach



Swine Nutrition A Practical Approach

- ▶ **Swine production is an industry**
- ▶ **70% cost of production is feed associated**
- ▶ **Improper feeding and its management decreases productivity leading to loss**
- ▶ **This module will help you'll to learn on Swine Nutrition in a practical way**

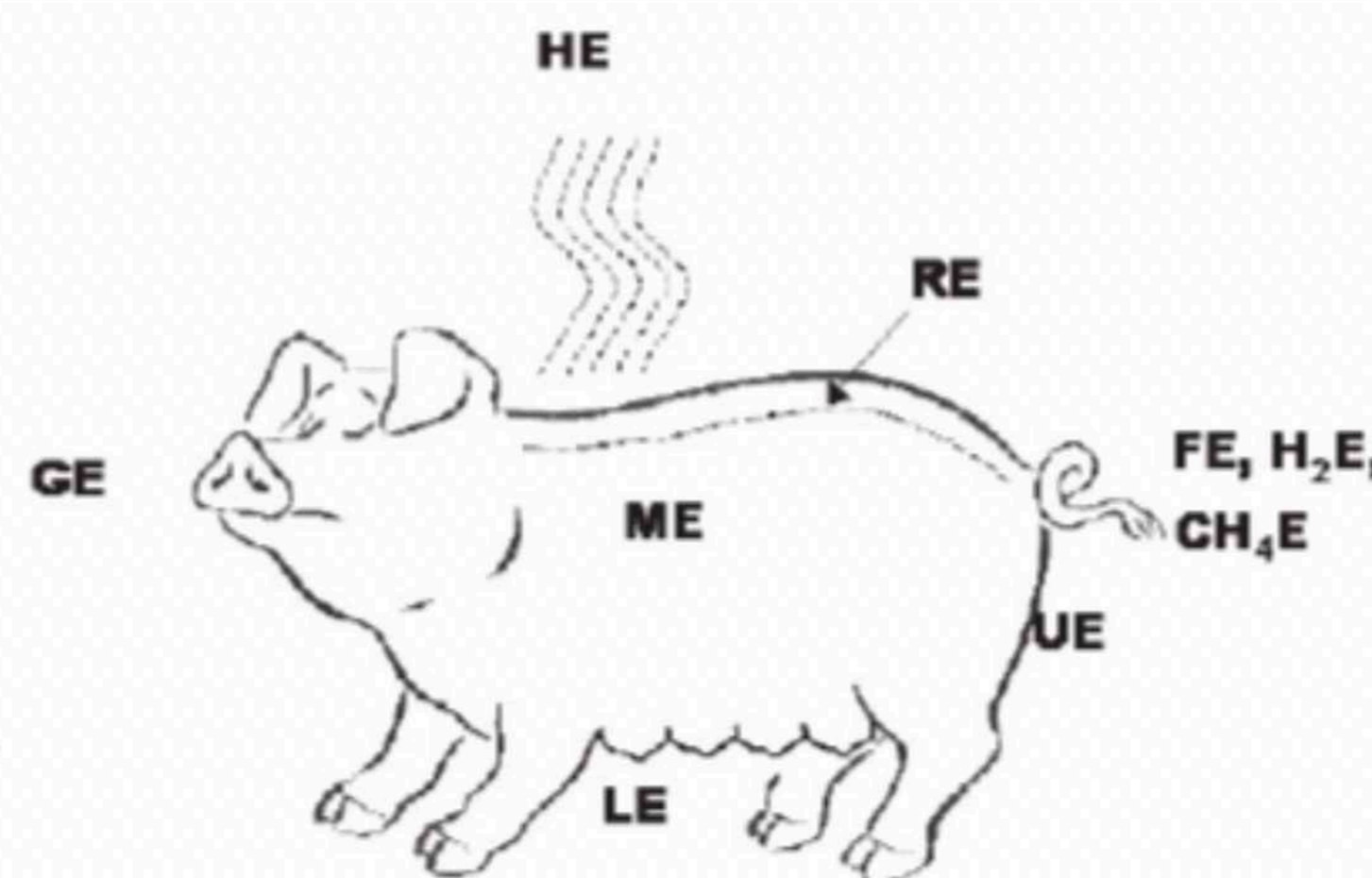
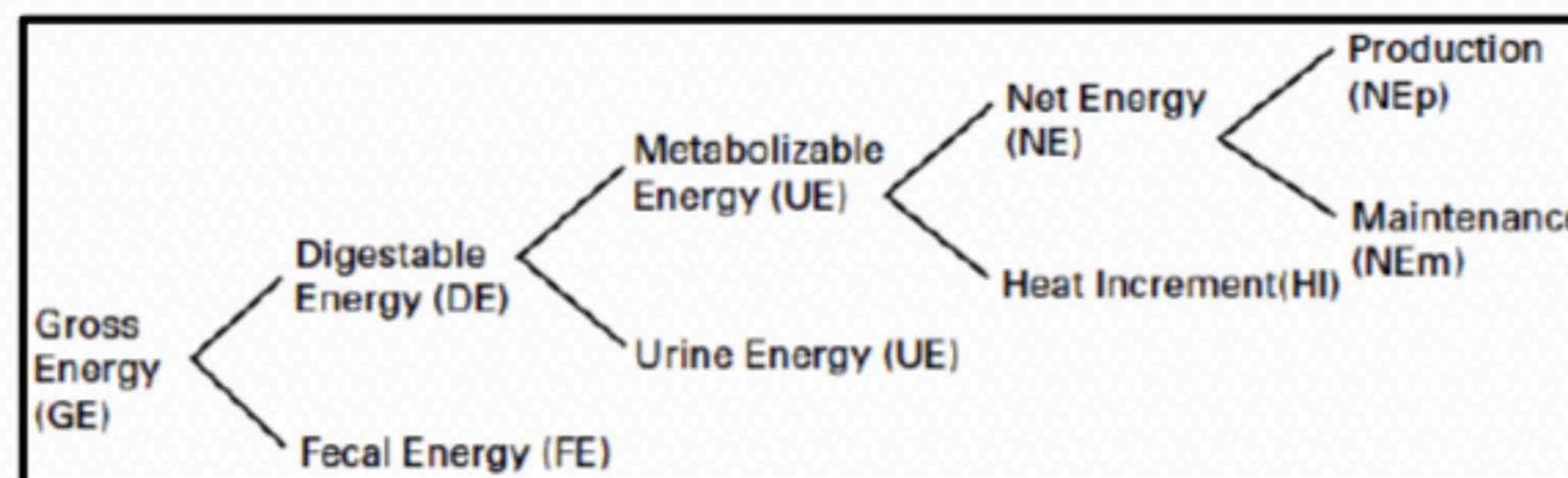
ENERGY

- ▶ Energy requirements are expressed as kilocalories (kcal) of digestible energy (DE), metabolizable energy (ME), or net energy (NE).

DE and ME values are used most commonly, Energy requirements of pigs are influenced by

- ★ their weight
- ★ their genetic capacity for lean tissue growth or milk production
- ★ the environmental temperature at which they are housed.

- ▶ The amount of feed consumed by pigs is controlled principally by the energy content of the diet.
- ▶ If the energy density of the diet is increased by including supplemental fat, voluntary feed consumption decreases.



ENERGY REQUIREMENT

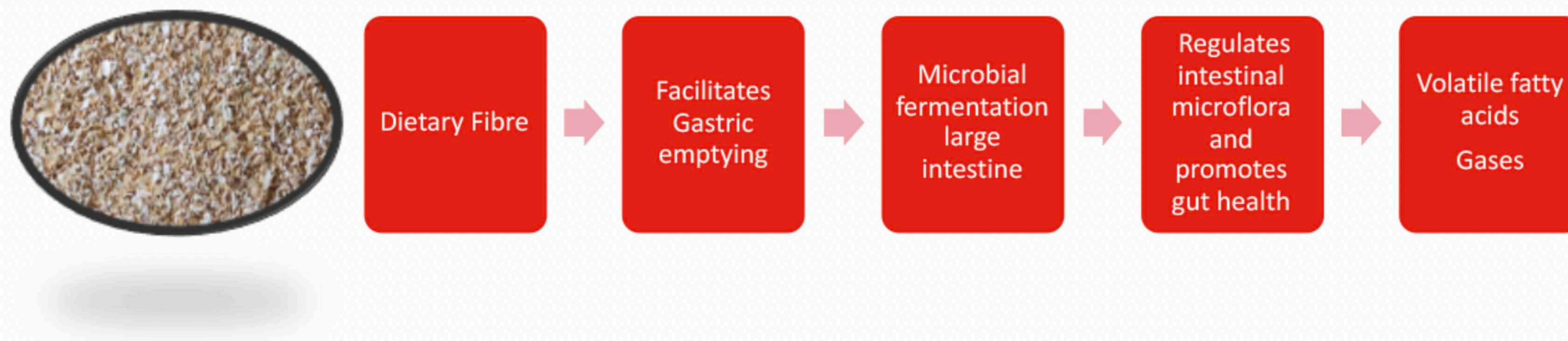
► Growing pigs

Body weight (KG)	5–7	7–11	11–25	25–50	50–75	75–100	100–135
ME content of diet (kcal/kg)	3,400	3,400	3,350	3,300	3,300	3,300	3,300

Gestating and Lactating Sows - ME content of diet – 3300 Kcal/Kg

CRUDE FIBRE REQUIREMENT

- ▶ Pigs can utilize crude fibre to a lower extent.
- ▶ The utilization of fibre by the pigs depends on the age of and weight of pigs and characteristic of non-fibrous portion of the ration.
- ▶ For **growing and finishing pigs 5-6% CF** level in their diet is recommended.
- ▶ In **sows, 10-12%** level of CF in diet can be well tolerated.



CRUDE PROTEIN REQUIREMENT

▶ Growing pigs

Body weight (KG)	5-7	7-11	11-25	25-50	50-75	75-100	100-135
Crude protein (%)	24-26	22-24	21-23	19.3	17.1	15.2	13.4

▶ Sows

	Day of gestation				Parity	
	0-90	90-115	0-90	90-115	1	2 & above
Crude protein (%)	11.9	14.7	9.6	12.0	16.6	16.1

Protein requirement - % in feed

	Class of Pig	% of protein in diet
1.	Pigs - preweaning/creep feed	18-22
2.	Weaned pigs	16
3.	Growing pigs '45 kg body wt'	14
4.	Breed gilts	15
5.	Sows	14
6.	Breeding boars	14
7.	Lactating sow	15

Swine - Dietary essential amino acids

- ▶ Arginine
- ▶ Histidine
- ▶ Isoleucine
- ▶ Leucine
- ▶ Lysine
- ▶ Methionine
- ▶ Phenylalanine
- ▶ Threonine
- ▶ Tryptophan
- ▶ Valine.



Cystine and tyrosine can meet a portion of the requirement for methionine and phenylalanine

AMINO ACID REQUIREMENT

▶ Growing pigs

Body weight (KG)	5-7	7-11	11-25	25-50	50-75	75-100	100-135
Lysine (%)	1.70	1.53	1.40	1.12	0.97	0.84	0.71
Methionine (%)	0.49	0.44	0.40	0.32	0.28	0.25	0.21

▶ Gestating and Lactating Sows

	Day of gestation				Parity	
	0-90	90-115	0-90	90-115	1	2 & above
Lysine (%)	0.61	0.80	0.45	0.62	0.93	0.90
Methionine (%)	0.18	0.23	0.13	0.18	0.25	0.24

MINERAL REQUIREMENT – GROWING PIGS

Body weight (KG)	5–7	7–11	11–25	25–50	50–75	75–100	100–135
Calcium (%)	0.85	0.80	0.70	0.66	0.59	0.52	0.46
Phosphorus, total (%)	0.70	0.65	0.60	0.56	0.52	0.47	0.43
ATTD phosphorus (%)	0.41	0.36	0.29	0.26	0.23	0.21	0.18
Sodium (%)	0.40	0.35	0.28	0.10	0.10	0.10	0.10
Chlorine (%)	0.50	0.45	0.32	0.08	.08	0.08	0.08
Magnesium (%)	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Potassium (%)	0.30	0.28	0.26	0.23	0.19	0.17	0.17
Copper (ppm)	6.00	6.00	5.00	4.00	3.50	3.00	3.00
Iodine (ppm)	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Iron (ppm)	100	100	100	60	50	40	40
Manganese (ppm)	4.00	4.00	3.00	2.00	2.00	2.00	2.00
Selenium (ppm)	0.30	0.30	0.25	0.20	0.15	0.15	0.15
Zinc (ppm)	100	100	80	60	50	50	50

MINERAL REQUIREMENT - SOWS

	Day of gestation				Parity	
	0-90	90-115	0-90	90-115	1	2 & above
Calcium (%)	0.61	0.83	0.49	0.72	0.71	0.68
Phosphorus, total (%)	0.49	0.62	0.41	0.55	0.62	0.60
STTD phosphorus (%)	0.27	0.36	0.21	0.31	0.36	0.34
ATTD phosphorus (%)	0.23	0.31	0.18	0.27	0.31	0.29
Sodium (%)	0.15	0.15	0.15	0.15	0.20	0.20
Chlorine (%)	0.12	0.12	0.12	0.12	0.16	0.16
Magnesium (%)	0.06	0.06	0.06	0.06	0.06	0.06
Potassium (%)	0.20	0.20	0.20	0.20	0.20	0.20
Copper (ppm)	10.00	10	10	10	20	20
Iodine (ppm)	0.14	0.14	0.14	0.14	0.14	0.14
Iron (ppm)	80	80	80	80	80	80
Manganese (ppm)	25	25	25	25	25	25
Selenium (ppm)	0.15	0.15	0.15	0.15	0.15	0.15
Zinc (ppm)	100	100	100	100	100	100

VITAMIN REQUIREMENT – GROWING PIGS

Body weight (KG)	5-7	7-11	11-25	25-50	50-75	75-100	100-135
Vitamin A (IU/kg) ⁱ	2,200	2,200	1,750	1,300	1,300	1,300	1,300
Vitamin D (IU/kg) ⁱ	220	220	200	150	150	150	150
Vitamin E (IU/kg) ⁱ	16	16	11	11	11	11	11
Vitamin K (menadione, mg/kg)	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Biotin (mg/kg)	0.08	0.05	0.05	0.05	0.05	0.05	0.05
Choline (g/kg)	0.60	0.50	0.40	0.30	0.30	0.30	0.30
Folacin (mg/kg)	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Niacin, available (mg/kg) ^j	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Pantothenic acid (mg/kg)	12.00	10.00	9.00	8.00	7.00	7.00	7.00
Riboflavin (mg/kg)	4.00	3.50	3.00	2.50	2.00	2.00	2.00
Thiamine (mg/kg)	1.50	1.00	1.00	1.00	1.00	1.00	1.00
Vitamin B ₆ (mg/kg)	7.00	7.00	3.00	1.00	1.00	1.00	1.00
Vitamin B ₁₂ (mcg/kg)	20.00	17.50	15.00	10.00	5.00	5.00	5.00

VITAMIN REQUIREMENT - SOWS

	Day of gestation				Parity	
	0-90	90-115	0-90	90-115	1	2 & above
Vitamin A (IU/kg)	4,000	4,000	4,000	4,000	2,000	2,000
Vitamin D (IU/kg)	800	800	800	800	800	800
Vitamin E (IU/kg)	44	44	44	44	44	44
Vitamin K (menadione, mg/kg)	0.50	0.50	0.50	0.50	0.50	0.50
Biotin (mg/kg)	0.20	0.20	0.20	0.20	0.20	0.20
Choline (g/kg)	1.25	1.25	1.25	1.25	1.00	1.00
Folacin (mg/kg)	1.30	1.30	1.30	1.30	1.30	1.30
Niacin, available (mg/kg)	10	10	10	10	10	10
Pantothenic acid (mg/kg)	12	12	12	12	12	12
Riboflavin (mg/kg)	3.75	3.75	3.75	3.75	3.75	3.75
Thiamine (mg/kg)	1.00	1.00	1.00	1.00	1.00	1.00
Vitamin B ₆ (mg/kg)	1.00	1.00	1.00	1.00	1.00	1.00
Vitamin B ₁₂ (mcg/kg)	15	15	15	15	15	15

Ration

- ▶ Ration is the feed given to an animal over a period of 24 hours

Factors to be considered for ration formulation

- ▶ **Acceptability to the animal**
- ▶ **Digestibility**
- ▶ **Cost - The least-cost ration should ensure that the requirements of the animal are met and the desired objectives are achieved.**
- ▶ **Presence of anti-nutritional factors and toxins.**
- ▶ **Other factors that should be considered are texture, moisture and the processing the feed has to undergo.**



Steps in ration formulation

- ▶ **The nutrient requirements can be arrived using feeding standards.**
- ▶ **The list of commonly available feeds in that region is prepared.**
- ▶ **The nutritional value of the feeds is obtained from any standard source such as NRC.**

INGREDIENTS FOR RATION FORMULATION

▶ Energy sources

- Cereal grains - corn, sorghum, wheat, rice and barley
- Fats and oils



▶ Protein Sources

- Part of the protein in a swine ration will come from cereal grains.
- Protein supplements - soybean meal, peanut meal, milk byproducts, fish meal, meat and bone meal



SUPPLEMENTS

▶ Vitamin premix

- **Vitamin A** **800,000 I.U.**
- **Vitamin D** **80,000 I.U.**
- **Vitamin E** **3,000 I.U.**
- **Vitamin K** **660 mg.**
- **Riboflavin** **1,000 mg.**
- **Pantothenic Acid** **4,500 mg.**
- **Niacin** **7,000 mg.**
- **Choline Chloride** **20,000 mg.**
- **Vitamin B12** **5 mg.**



▶ Mineral Mixture

Nutritional Value/20 gm.	
Calcium	2700 mg
Phosphorus	80 mg
Magnesium	5000 mg
Manganese	2000 mg
Iron	2000 mg
Iodine	350 mg
Copper	4500 mg
Zinc	9800 mg
Cobalt	200 mg
Sodium	500 mg
Selenium	15 mg
Vitamin A	800000 IU
Vitamin D	8000 IU]
Vitamin E	300 mg
D,L - Methionine	300 mg

Benefits:

1. Maintain normal ruminal pro
2. Maintain normal health
3. Improves meat quality
4. Supplements for essential min

Dosage:

Pig/Piglets: 10 – 25 gm/dail
Or, 0.5 – 1% in feed



Ingredient composition

Ingredient	ME kcal/lb.	Crude Protein %	Calcium %	Phosphorus %
Alfalfa meal, dehydrated	1020	17.00	1.30	0.23
Barley	1275	11.70	0.06	0.23
Corn, Yellow	1500	8.80	0.01	0.25
Fat, Animal	3550	-	-	-
Meat and bone meal	1100	50.00	8.10	4.10
Milk, dried skim	1520	33.30	1.25	1.00
Sorghum Grain	1425	9.00	0.02	0.27
Oats	1220	12.00	0.08	0.33
Oat groats	1500	16.00	0.07	0.40
Peanut meal, solvent	1320	47.00	0.20	0.65
Soybean meal	1475	44.00	0.25	0.60
Tankage	980	60.00	4.00	2.60
Wheat	1500	12.20	0.05	0.35
Wheat bran	890	15.00	0.08	1.15
Wheat middlings	1300	16.00	0.05	0.80

METHODS OF RATION FORMULATION

- ▶ Trial and error method of calculating rations with the use of simple electronic calculators.
- ▶ Algebraic method.
- ▶ Linear programmed least cost rations.



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TRIAL AND ERROR METHOD

- ▶ Fix slack space: 2 kg For nutritive (mineral mixture, salt) and non-nutritive feed additives, added at later stage while balancing the ration.
- ▶ Fix level of cereal by-products i.e. DORB : 07 kg, 20 kg and 25 kg for pig starter, pig growth meal and pig finisher feeds, respectively.
- ▶ Fix level of animal protein source i.e. Fish meal: 10 kg, 7 kg and 5 kg for Pig starter, Grower and Finisher meals, respectively.
- ▶ Calculate proportion of Energy feed and Vegetable protein – Trial and error / Pearson square method
- ▶ Balance ME content
- ▶ Balance Calcium and Available phosphorus
- ▶ Check Crude fiber level: calculate CF contributed by different feed ingredients, total it and compare with recommended Max. CF levels given in the feeding standard, it should not be higher than that level. If, CF level is slightly higher, supplementation of fiber digesting enzyme preparations may be recommended.
- ▶ Finally total, quantities of feed ingredients and each nutrients, it should match with the recommended nutrient levels given in the feeding standards.
- ▶ Vit supplements are necessarily added @ 25 g/100 kg each.

Algebraic method

Fix the nutrient requirements for the feed to be formulated

- ▶ Slack space for additives 0.5%
- ▶ Slack space for lysine – 0.05
- ▶ Slack space for methionine – 0.15
- ▶ Slack space for common salt if fish meal not included – 0.4
- ▶ Slack space for calcium and phosphorus.
- ▶ Fix level of animal origin protein source if it is going to be included max10%
- ▶ Fix level of cereal milling byproducts to be included (refer maximum inclusion level)
- ▶ Calculate the total of the ingredients so far added.
- ▶ Assuming that the following is the list of ingredients selected

Ingredients	Inclusion level	CP	ME Kcal/Kg
Maize			
Soya bean meal			
Fish meal	8	4	224
Rice polish	5	0.55	150
Lysine	0.05		
Methionine	0.15		
Additives	0.5		
Mineral mixture (Calcium, P etc)	2		
		4.55	324

Total of ingredients other than Maize and Soya bean meal = 15.70

- Balance from maize and Soya bean meal = $100 - 15.70 = 84.30$
- Total Protein requirement = 20 %
- Protein already supplied = 4.55
- Balance protein required = 15.45

Let X = Maize and Y = Soya bean meal

- $X + Y = 84.3$ (Equation 1)
- $0.09 X + 0.50 Y = 15.45$ (Equation 2)

Multiplying Equation 1 with 0.50

- $0.50 X + 0.50 Y = 42.15$ (Equation 3)

Subtracting equation 2 from equation 3

- $0.41 X = 26.7$
- $X = 65.12 = 65$
- $Y = 84.3 - 65.12 = 19.18 = 19.2$

Ingredients	Inclusion level	CP	ME Kcal/Kg
Maize	65	5.85	2145
Soya bean meal	19.2	9.6	518
Fish meal	8	4	224
Rice bran	5	0.55	135
Lysine	0.05		
Methionine	0.15		
Additives	0.5		
Mineral mixture (Calcium, P etc)	2		
Extra ricebran	0.1	0.011	2.7
Total	100	20.07	3024.7

THE PEARSON SQUARE

Is designed for simple rations.

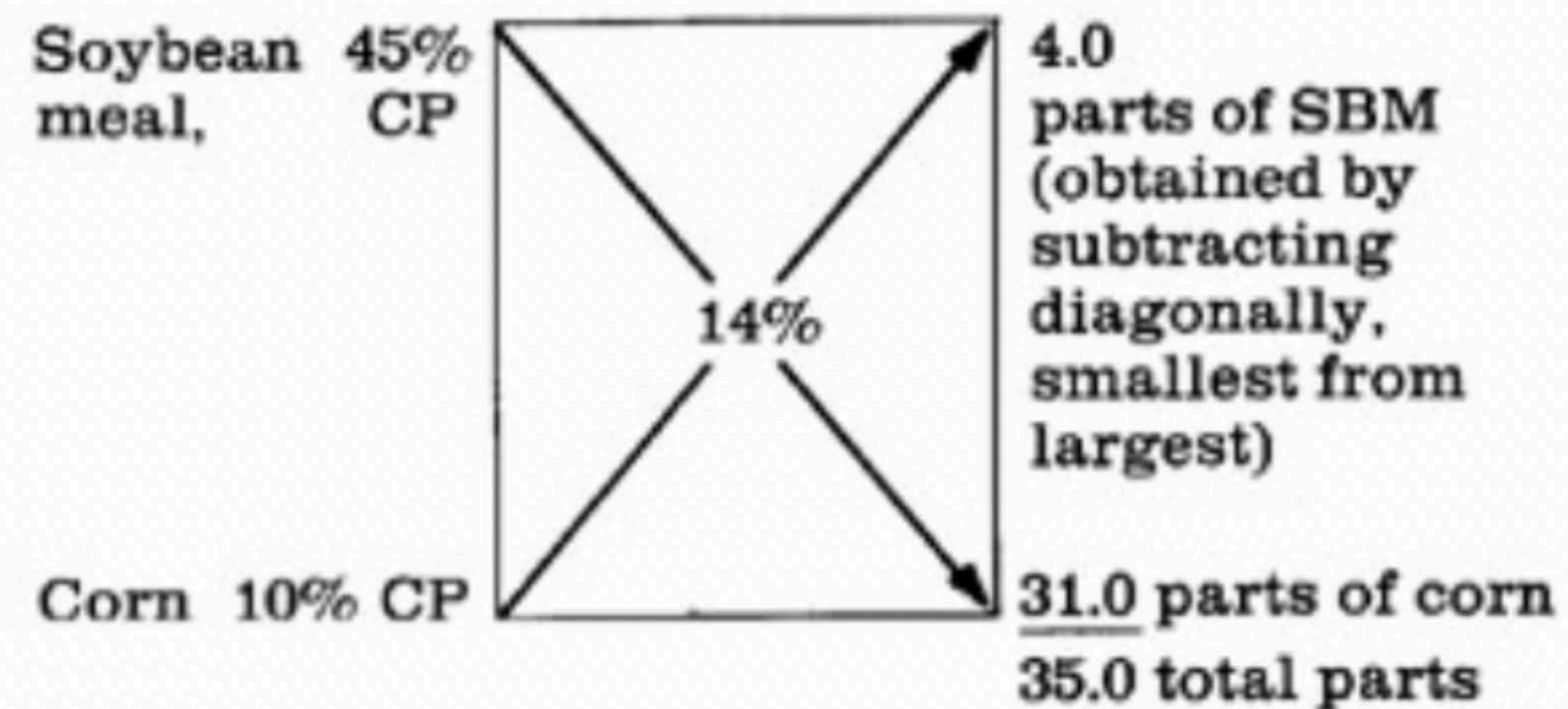
1. The value in the middle of the square must be intermediate between the two values that are used on the left side of the square.

For example, the 14 percent crude protein requirement has to be intermediate between the soybean meal that has 45 percent crude protein or the corn that has 10 percent crude protein.

2. Disregard any negative numbers that are generated on the right side of the square. Be concerned only with the numerical differences between the nutrient requirement and the ingredient nutrient values.

3. Subtract the nutrient value from the nutritional requirement on the diagonal and arrive at a numerical value entitled parts.

4. By summing those parts and dividing by the total, you can determine the percent of the ration that each ingredient should represent in order to provide a specific nutrient level.



1. Corn represents $(31.0 / 35.00) \times 100$ of the ration, or 88.57 percent.
2. Soybean meal represents $(4.0 / 35.00) \times 100$ of the ration, or 11.43 percent.

88.57 lb corn x 10.0% CP	=	8.86
<u>11.43 lb</u> SBM x 45.0% CP	=	<u>5.14</u>
100.00 lb mixture contains	=	14.00 lb CP, or 14 percent.

What was learnt

- ▶ ***Nutrient requirements – Energy, Protein, amino acids, crude fibre, minerals, vitamins***
- ▶ ***Ingredients***
- ▶ ***Ration***
- ▶ ***Ration formulation***



Thank you