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Rabbit Pellet Formula Study Using Animal Feed Calculator

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Abstract: Current rabbit farmers are too dependent on commercial rabbit pallet and this led to high rabbit meat price. In this study, the first objective is to study suitable ingredients for rabbit pellet based on their nutrients need. The second objective is to produce rabbit feed formula using animal feed calculator. The third objective is to produce rabbit feed formula which is 20%-30% cheaper than commercial price (RM 27 per 3 kg). Firstly, the Hand Pearson Square Method was used to generate rabbit pellet formula. To speed up the calculation process, the Hand Pearson Square Method was converted into a Microsoft Excel and rabbit feed formula where it is found that the cost is approximately RM 27 per 3 kg of pellet. All the ingredients must be weighed according to this Excel calculation. Water spinach, pineapple, carrot, cucumber, molasses, soybean hull, sunflower seed, anchovies head used are 140 g, 140 g, 10 g, 70 g, 150 g, 500g, 40 g, and 270 g respectively. All ingredients were mixed well with molasses and slowly added with water to obtain dough texture before it is shaped as a pellet using meat mincer. Finally, the pellet is dried in the oven at 50 to 60 Celsius until the pallet is dried completely. The result shows the value of rabbit pallet for gestation stages using animal feed calculator for crude protein which are 21.22%, crude fibre is 16.83%, calcium is 1.63% and phosphorus is 0.41% meet the requirement in Department of Veterinary Services. In Department of Veterinary Services, the nutrition content (%) for crude protein is 21.3%, crude fibre is 16.8%, calcium is 0.03% and phosphorus is 0.59% for gestation stage. Yield cost to produce rabbit pallet is approximately for 3 kg pallet is RM 25.35. The good palatability was achieved when wheat powder was added as a binding agent to produce the correct pallet texture.

Keywords: Rabbit Pallet, Rabbit Feed Formula, Hand Pearson Square Method

1. Introduction

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Rabbits are small mammals in the family Leporidae. They prefer nutrient-rich leaves and fresh plant shoots compared to more mature plant material which high in fibre. Rabbit meat is also good quality due to its high protein level and low fat and cholesterol content.

The growing demands for rabbit meat has contributed to the high cost of concentrated feed for rabbits, and this has become a big issue for most farmers. Current rabbit farmers are too dependent on commercial rabbit pallet and this led to high rabbit meat price. The first objective of this study is to study suitable ingredients for rabbit pellet based on their nutrients content. The second objective of this study is to produce rabbit feed formula using animal feed calculator. The third objective of this study is to produce rabbit feed formula which is 20%-30% cheaper than commercial price (RM 27 per 3 kg). That's why this study is to focus more on the animal feed calculator via Microsoft excel and rabbit pallet production.

Rabbits are categorized as small herbivores and are known to be very selective eaters. They also have unique feeding needs and digestive systems [1]. Feeding an appropriate diet to a rabbit is probably the single most important factor in maintaining its health. Based on study the best rabbit diet must include five specific amount of nutrients which are dry matter, fibre, protein, energy, calcium and phosphorus [2]. Next, the vitamins are an essential nutrient for rabbits as rabbits cannot produce their own vitamins. They required all vitamins except for vitamin C as excess of vitamin C can cause kidney damage [3]. The requirements of vitamin A differ according to their life stages. Both deficiency and excessive vitamin A resulted in poor reproductive performance. A desirable amount of fibre for pet rabbits is 18% to 25% DM.

Hay should make up the bulk of a rabbit's diet due to its high fibre content. It can protect the rabbit's stomach and intestines and stops any overgrowth of bacteria in the digestive tract [4]. Rabbits require a calcium level limited to 0.5% to 1% DM. Calcium and phosphorus is important in rabbits' diets. Dried plantain skin has calcium and phosphorus that could enhance growth performance and nutrient digestibility without compromising economic gain in rabbit production [5]. Moreover, binder also needed in the nutritious requirement for rabbit such as molasses. Molasses is a viscous product resulting from refining sugarcane or sugar beets into sugar. The amount used in dry feeds is usually small, lower than 15% DM and usually in the 2-5% range [6]. Most foods contain 2% to 5% DM fat, which rabbits can get from a vegetable diet. Fat can increase palatability but an excess amount can increase the risk of obesity, hepatic lipidosis, and atherosclerosis in the aorta [7].

A diet high in grain or fermentable fibre, such as oats and corn, can cause enteritis. Fermentable fibre helps rabbits digest cecotropes as well as prevents colonization of the cecum by pathogenic bacteria, helping to prevent bacterial overgrowth and decreasing the likelihood of enteritis [8]. In order to do rabbit formula study using animal feed calculator the Hand Pearson Method was used. The Pearson square or box method of balancing rations is a simple procedure because it will have a tool that can be used to calculate the portion of two feeds needed to meet protein or energy requirements of an animal. Before using this animal feed calculator, the Pearson box method will be used first to produce pellet in desired amount that we need. For this tool to work, one of the feeds used must be higher in ME or CP than the desired level and the other feed must below the desired level. Binding agents are added in the pallet to help it harden. This is because all of the ingredients in a recipe are chemically held together by the gluten found in wheat flour, which acts as a binder [9].

2. Materials and Methods

2.1 Materials

The main ingredients are water spinach, pineapple skin, carrot, cucumber, molasses, soybean hull, sunflower seed, and anchovies head. All ingredients were discussed and refer the nutritional content in department of veterinary services and have been study the benefits as mentioned in introduction in paragraph three. All these ingredients must be dry in the food dehydrator to maintain their nutritional

value and all the ingredients must be completely in dry-texture. The exact time to get these ingredients dry approximately up to one day. After completely dry all these ingredients must be blender separately until it become powder. All the ingredients must be weighed according to the animal calculator feed formula for gestation rabbit. Water spinach weigh is 140 g, pineapple skin is 140 g, carrot is 10 g, cucumber is 70 g, molasses is 150 g, soybean hull is 500g, sunflower seed is 40 g, anchovies head is 270 g. All ingredients mix well with molasses and add water little by little until get the dough texture then it can be shaped using meat mincer. For drying process, the pallet is dry in the oven at 50 to 60 Celsius until the pallet is dried completely. Lastly, the sample of the rabbit pallet is sent to the lab for chemical testing.

2.2 Method

First, water spinach, pineapple skin, carrot, cucumber, sunflower seed and anchovies head is dry overnight in the food dehydrator at 65 ˚C. Then, meat mincer is installed. After that, preheated oven at 100˚ C. Next, grinding all raw dried ingredients separately by using grinder machines. Sift all ingredients until it becomes uniform size. Weight all the sift ingredients using analytical balance. Water spinach weigh is 140 g, pineapple skin is 140 g, carrot is 10 g, cucumber is 70 g, molasses is 150 g, soybean hull is 500g, sunflower seed is 40 g, anchovies head is 270 g. Mix well all the ingredients using mixer and cover it with aluminium foil. Add water little by little until all ingredients mix well. The mixed ingredients is inserted into body of the meat mincer. For drying process, the pallet is place distance all over oven plate. The pellet is dried in the oven at 50 to 60 Celsius until the pellet is dried completely.

2.3 Calculation of diet formulation by Hand Pearson square method Via Microsoft Excel

Hand Pearson method was developed by Karl Pearson from a related idea introduced by Francis Galton in the 1880s, and for which the mathematical formula was derived and published by Auguste Bravais in 1844. The Pearson square or box method of balancing rations is a simple procedure because it will have a tool that can be used to calculate the portion of two feeds needed to meet protein or energy requirements of an animal. Before using this animal feed calculator, the Pearson box method will be used first to produce pellet in desired amount that we need. For this tool to work, one of the feeds used must be higher in ME or CP than the desired level and the other feed must be below the desired level.

Figure 1 indicates method of Hand Pearson square for rabbit pallet. First of all, draw a 1-to-2-inch square. Place diagonal line across the square. Then, write the percentage of crude protein needed by the animal in the centre of the square where the diagonal lines cross. Next, write the feeds to be used at each corner. Place the percent of the crude protein in the feeds after the name of the feed. For step four, subtract the smaller of the numbers from the larger numbers. This involves crude protein needed by the animal and that provided by the feed. Write the difference in the opposite corners. Then, the number at the two right corners are parts of the two feed ingredients that are needed. After that, the percentage of each feed needed in the ration can be found by dividing the number of parts by the total parts then multiple by 100. Lastly, the amount of each feed ingredients for a large batch of feed is determined by multiplying the percentage of each by the total amount of feed desired. Since Hand Pearson method takes time to solve manually, solving this calculation using Microsoft Excel will be much easier.

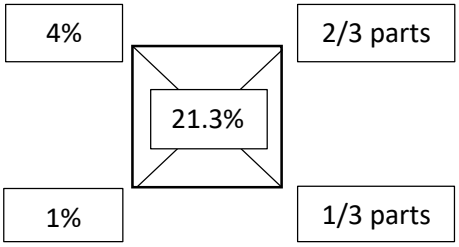


Figure 1: Method of Hand Pearson square for rabbit pallet

Example of manual calculation of Hand Pearson Square method to determine the percentage of Protein,

Percentage of protein needed by rabbits: 21.3%

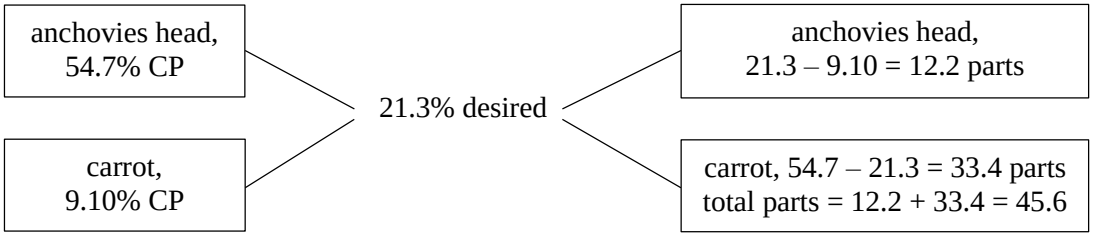
Weight of protein portion from 1kg feed pallets,

$$\frac{21.3}{100} \times 1000g = 213g$$

Example of manual calculation of Hand Pearson Square method to determine animal diet formulation,

Crude protein of anchovies head: 54.7%

Crude protein of carrot: 9.10%



$$\%\ \text{Anchovies Head} = \frac{\text{part}}{\text{total parts}} = \frac{12.2}{45.6} \times 100g = 26.75\ \%$$

$$\%\ \text{Carrot} = \frac{\text{part}}{\text{total parts}} = \frac{33.4}{45.6} \times 100g = 73.25\ \%$$

$$\text{Weight of anchovies head in 213 g of feed} = \frac{26.75}{100} \times 213g = 56.9g$$

Figure 2 outlines the summary of all Hand Pearson square method calculations using Microsoft Excel. The formula are embedded into the associated rows and column thus changing the value of material weight in the green columns will result in changes of the following columns on the right side.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	KALKULATOR FORMULASI MAKANAN TERNAKAN														
2										89.7	9.46	21.2	16.8	0.03	0.38
3	BAHAN MAKANAN		BERAT (KG)	DM (%)	ME (MJ/KG)	CP (%)	CF (%)	Ca (%)	P (%)	DM (KG)	ME (MJ)	CP (KG)	CF (KG)	Ca (KG)	P (KG)
4	Kangkung (m/s 12)	0.28	0.14	98%	8.48	23.70%	15.30%	0.53%	0.68%	0.1372	1.1635	0.0325	0.0210	0.0007	0.0009
5	pineapple 1 (m/s 25)	0.28	0.14	98%	11.52	5.30%	10.70%	0.20%	0.10%	0.1372	1.5805	0.0073	0.0147	0.0003	0.0001
6	carrot (refere fedipedia)	0.02	0.01	98%	11.9	9.10%	10.00%	0.04%	0.03%	0.0098	0.1166	0.0009	0.0010	0.0000	0.0000
7	cucumber (ripe)	0.14	0.07	98%	0	0.65%	0.32%	0.14%	0.00%	0.0686	0.0000	0.0004	0.0002	0.0001	0.0000
8	molasses (2) (m/s 19)	0.3	0.15	81%	12.61	3.70%	0.00%	0.92%	0.23%	0.1215	1.5321	0.0045	0.0000	0.0011	0.0003
9	soybean hull(m/s 23)	1	0.5	87%	10.86	14.00%	35.00%	0.75%	0.55%	0.4350	4.7241	0.0609	0.1523	0.0033	0.0024
10	sun flower old seed (m/s 22)	0.08	0.04	98%	0	15.80%	35.50%	0.12%	0.23%	0.0390	0.0000	0.0062	0.0138	0.0000	0.0001
11	kepala ikan bilis (m/s 22)	0.54	0.27	98%	3.18	54.70%	0.40%	4.00%	0.43%	0.2646	0.8414	0.1447	0.0011	0.0106	0.0011
12	JUMLAH	0.01	1.32							1.21	9.96	0.26	0.20	0.02	0.00
13					Tambahan:					91.89%	8.2102919	21.22%	16.82%	1.33%	0.41%
14	JUMLAH (KG)	2.64			Molasses	3%	0.0396	kg		DM	Tenaga	Protein	Serat	Kalsium	Fosforus
15	Nota				Tricalcium 36%	1%	0.0132	kg							
16	Dry Matter (Bahan Kering)		DM		Vitamin Premix	1%	0.0132	kg							
17	Metabolisable Energy (Tenaga Metabolisme)		ME		Garam	0.50%	0.0066	kg							
18	Crude Protein (Protein Kasar)		CP												
19	Crude Fiber (Serat Kasar)		CF												
20	Calcium (Kalsium)		Ca												
21	Phosphorus (Fosforus)		P												

Figure 2: Calculation of diet formulation by Hand Pearson square method via Microsoft Excel

3. Results and Discussion

3.1 Requirement Nutritional of Gestation Rabbit Using Animal Feed Calculator

Table 1: Final weight of ingredients obtained from animal calculator feed formula via Microsoft Excel

No	Ingredients	Weight (kg)	CP(%)	CF(%)	Ca(%)	P(%)	CP(kg)	CF(kg)	Ca(kg)	P(kg)
1	Water spinach	0.14	23.70	15.30	0.53	0.68	0.0325	0.0210	0.0007	0.0009
2	Pineapple	0.14	5.30	10.70	0.20	0.10	0.0073	0.0147	0.0003	0.0001
3	Carrot	0.01	9.10	10.00	0.04	0.03	0.0009	0.0010	0.0000	0.0000
4	Cucumber	0.07	0.65	0.32	0.14	0.00	0.0004	0.0002	0.0001	0.0000
5	Molasess	0.15	3.70	0.00	0.92	0.23	0.0045	0.0000	0.0011	0.0003
6	Soybean hull	0.50	14.00	35.00	0.75	0.55	0.0609	0.1523	0.0033	0.0024
7	Sunflower seed	0.04	15.80	35.50	0.12	0.23	0.0062	0.0138	0.0000	0.0001
8	Anchovies	0.27	54.70	0.40	4.00	0.43	0.1447	0.0011	0.0106	0.0011
	Total	1.32					0.26	0.20	0.02	0.00
							21.22%	16.82%	1.33%	0.41%
							Protein	Fibre	Calcium	Phosphorus

Table 1 shows the final weight of ingredients to make rabbit pallet. This shows our rabbit pallet for gestation stages meet the requirement in Department of Veterinary Services Ministry of Agriculture and Agro Based Industry Malaysia. In DVS the nutrition content (%) for crude protein, crude fibre, calcium and phosphorus for gestation stage are 21.3%, 16.8%, 0.05% and 0.59%. In the rabbit, food intake and urine calcium excretion both rises. In comparison to other mammals, humans can filter out a larger percentage of calcium from the blood. The range of calcium fractional excretion in rabbits is between 45 and 60 percent, while it is less than 2 percent in other animals. When the kidney's capacity for reabsorption is achieved, calcium precipitates as calcium carbonate in the rabbit's alkaline urine, resulting in murky or sluggish urine. When growth, pregnancy, breastfeeding, or metabolic diseases increase the metabolic need for calcium, less calcium is excreted, and the urine appears clear.

3.2. Cost Rabbit Pallet for 3 Kg

Table 2: Cost of rabbit pallet

No	Ingredients	Cost (RM)	Total (RM)
1	Water spinach	RM 28.00	RM 3.92
2	Pineapple	RM 0.00	RM 0.00
3	Carrot	RM 10.00	RM 0.10
4	Cucumber	RM 75.00	RM 5.25
5	Molasses	RM 0.50	RM 0.08

6	Soybean hull	RM 1.40	RM 0.70
7	Sunflower seed	RM 7.50	RM 0.30
8	Anchovies	RM 3.00	RM 0.81
9	Corn powder	RM 1.99	RM 0.10
10	Starch powder	RM 2.00	RM 0.10
11	Wheat powder	RM 3.90	RM 0.15
		Total per kg	RM 8.80
		Total per 3 kg	RM 26.40

Table 2 shows the total cost production of the rabbit pallet for 3 kg is RM 26.40 the total cost per 1 kg is RM 8.80. Meanwhile the breakdown of cost for each individual ingredient are as listed.

3.3 Price comparison from competitors in the market

Table 3: Competitor price in the market

No.	Product	Nutritional content (%)	Price
1.		CP (min): 15% CF (max) :16% ME (min): 2.5% Moisture (max): 10%	RM 34.10 per 3 kg
2.		CP (min): 19.0% CF (max): 28.5% Ca (min): 0.8% P (min): 0.4%	RM 29.00 per 1 kg
3.		CP (min) :17% CF (max) :18.0% Ca (max): 1.05% P (min): 0.5%	RM 98.90 per 3.6 kg

The cost of rabbit pallet produced in this study was compared the competitor price available in the market using top ecommerce website, Shopee. **Table 3** shows the price and nutritional content for each competitor. Hence, it is found out that products for all competitors are sold well above RM 27 per 3 kg. Based on this study and the use of animal feed calculator, the cost saving is approximately 20% up to 30% of production cost and might reach below RM 27 per 3 kg with future improvement.

3.4 Factors influencing the palatability

3.4.1 Texture of The Powder

During the pelleting process, all ingredients must be dried and blended into fine powder prior to mixing process. However, some ingredients are difficult to blend into fine powder form especially ingredients that contains high fibre like pineapple. If one of the blended ingredients is too coarse it will cause difficulties when mixing multiple ingredients together due to the differences of each particle size. The final pallet will have a rough and threaded texture because thick fiber threads will stick out from the pallet body. Besides that, the mixture will be hard to press through the mincer and shaped into consistent pallet shape and length. This will require additional processing time and effort while reducing the overall pallet yield.

3.4.2 Equipment of Making Pallet

It is recommended to use automatic food pellet machine or automatic food mincer for efficiency. At the time of this study conducted, there is only manual food mincer available in the food laboratory. There are some limitations using the manual food mincer, for example the insufficient pressure to pressed the pallet in order to obtain hard and correct pallet texture. Besides that, manual food mincer only allows small batch production compared to its automated version. Lastly, manual food mincer requires additional water added into the pallet mixture to aid the movement of pallet passing through the nozzle and pallet need to be dried up again after this pelleting process is complete.

3.4.3 Binding Agent

In order to provide structural stability, materials are formed into a cohesive structure using a binding agent, also known as a binder. There are three types of binder powder which are starch, corn and wheat. As shown in **Figure 3**, adding starch powder makes pallet ingredients bind finely and easily to shape but after the final drying process, the pallet feels fragile and brittle. Adding corn powder is not effective in making pallet ingredients bind together and will not improve the final pallet texture compared to not using any binder. The final pallet texture feels very soft and fragile too. The wheat powder is the best choice so far in this study. It makes pallet ingredients bind perfectly and help moving the mixture smoothly through manual mincer. The physical appearance after put into oven is hard and not fragile compared to using starch and corn powder. Pallet are shaken inside a plastic container for this purpose.

(a) (b) (c) (d)

Figure 3: The rabbit pallet shaped (a) that have not mix with either corn, starch nor wheat powder, (b) mix with starch powder, (c) mix with corn powder and (d) mix with wheat powder

4. Conclusion

This study aims to study suitable ingredients for rabbit pellet based on their nutrients content according to nutrition requirement that desire from DVS and livestock that can easily found to make a production of pallet. This study also focuses on produce rabbit feed formula using animal feed calculator that used Hand Pearson Square Method and can be simplified via Microsoft Excel. This study also focuses on producing rabbit feed formula which is 20%-30% cheaper than commercial price (RM 27 per 3 kg). This study proved that listed ingredients are affordable and can save up to 30% cost

production of pallet. Lastly, the importance of using pellet machine is can get good cylindrical shape of rabbit pellet.

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