

ABSTRACTS OF THE INTERNATIONAL CONFERENCE ON RABBIT PRODUCTION

BOGOR, INDONESIA, JULY 24-25, 2007.

The potential of the rabbit as a prolific and fast growing animal that is also able to grow and reproduce well from inexpensive forages, agricultural by-products, food industrial by-products, as well as from commercial pre-mixed diets, to produce a substantial amount of meat is well known. Therefore, rabbits can be raised in micro-(household) to small- or even large-scale operations (industry). This potential has already been realized in other developing countries where most farming systems involve small-scale backyard enterprises with very limited external inputs. In many cases, this small-scale system could help numerous households to have meat and also to significantly increase household cash income. Especially for the developing countries, including Indonesia, the potential benefits from farming rabbits are high, i.e. to strengthen food security, to earn additional income, provide job opportunities, and produce a high quality, healthy meat. However, presently the rate of expansion of rabbit farming is slow, although the interest of farmers is increasing, especially when the problem with poultry (Asian Flu Influenza) still exists.

This Conference is aimed at gathering information from research results that can help to support establishing a rabbit industry as a way to strengthen food security as well as to become a profitable business for rabbit farmers. The aim serves the theme of the Conference, which is Towards A Small-Medium Scale Rabbit Industry. There are 46 papers, 11 were from the overseas, while the rest were from all over Indonesia. Topics presented covers the area of management, nutrition, breeding, product processing, diseases and, rabbit project development.

I would like to thank the WRSA for sharing these Abstracts of papers in the WRS Journal.

Yono Raharjo

Conference Coordinator and President of the WRSA Indonesian Branch

MAIN PAPERS

STRATEGY ON THE DEVELOPMENT OF SMALL AND MEDIUM SCALE RABBIT PRODUCTION IN INDONESIA

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Rabbit industry can be a viable mean of improving the nutritional status, incomes and employment opportunity of the low income rural and urban farmers in Indonesia. However, with the over production of rabbit in 1980s, several regions have some reluctance in developing rabbit farming in their areas. Therefore, a new strategy has to be introduced to fit the current situation of rabbit development with the Indonesian's life styles nowad. Around big cities particularly in Java island, farming fancy rabbits for pet animal has developed. In major tourist destination in Java, such as Lembang (West Java), Magelang (Central Java), Sleman (DIY) and Batu (East Java), the demand for rabbit meat is very strong for

“satay” and processed meat such as sausages, nuggets, meat ball etc. Rabbit hide and skin as well as rabbit urine and faeces are also important products of rabbit farming in Indonesia. The government has responded to this new situation by launching several package programs. Starting in late 2006, the central government provided investment and working capital to selected farmers in selected areas in Java and outer islands (Tabanan in Bali and Karo in North Sumatra). This was followed by several activities such as demonstration on rabbit meat processing, training and extension, comparative studies, distribution of magazine, leaflets etc. Although rabbit development is not the main priority of the government, some efforts have been carried out to overcome the current constraints of rabbit development in Indonesia such as lack of improved breeds, inadequate feed, and the occurrence of some diseases particularly for young rabbit. Further development strategy of rabbit industry in Indonesia will be directed to boost production in major producing areas in Java and selected production centres in outer islands. Providing improved breeds, feed from local sources, training and extension, rabbit meat promotion and product diversification, expansion of market for rabbit meat and other associated products

are the main development strategy for rabbit industry in Indonesia.

Key words: strategy, development, small scale, medium scale, rabbit.

STRATEGY FOR THE DEVELOPMENT OF SMALL AND MEDIUM SCALE RABBIT FARMING

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To establish a dynamic and viable rabbit breeding industry, it is critical that a formal farmer training and development programme exists in the country. Indeed, farmer selection, training, and early on-farm supervision, and later, project multiplication or spread effect, serve as pivotal activities for a successful programme. The purpose for this paper is to outline key strategies that can be modified and implemented for any country to development such a program. Many country programmes have focused on rabbit projects as a means to target poverty alleviation. A sustainable system of rabbit production involves the use of renewable on-farm resources, such as local breeds, feedstuffs from forage or garden plots, local materials for hutches and other equipment, and family labor. The key is low investment and operating costs. In addition, the integration of rabbits with other farming enterprises generally results in "increasing the whole more than the sum its parts" (i.e., nutrient recycling among aquaculture, garden, and vermiculture activities). Families should be encouraged to either consume rabbit meat on a regular basis, or sell rabbits as a cash crop in order to purchase food of higher quality to improve the nutritional status of the family's diet. The upgrade from small- to medium-operations can occur once the farm abandons poverty and invests capital to expand his operation. Typically, this conversion is a shift from an enterprise based on on-farm self-reliance to off-farm purchases of supplies, for example, exotic breeds, commercial feeds, medications, and equipment, including hired labor. However, this upgrade is usually justified only in cases where well established markets exist near major cities where consumer demand or popularity of rabbit meat is high. A dynamic and viable rabbit breeding industry also depends on a cadre of rabbit scientists who engage in research activities that directly solve farmer problems.

Key words: rabbits, poverty alleviation, programme development, sustainability, training.

FEEDING STRATEGIES TO REDUCE ENTERITIS PROBLEMS IN RELATION TO SMALL AND MEDIUM SCALE RABBIT INDUSTRY

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Rabbits are known as fertile animals, however also as sensitive for enteritis problems leading to the main

cause of mortality in growing rabbits. Beside hygienic strategies, including "all in all out" measures, different feeding strategies have proved to be helpful to control these problems. An adequate coccidiosis prevention program, with e.g. in-feed anticoccidials, is necessary both in small as large scale rabbit production. Quite recently the role of low-digested and digestible fibre has been clarified in rabbit feeding for digestive troubles prevention. As a monogastric herbivorous animal, its digestive physiology is well adapted to high intake of plant cell walls. Apart from the important role of fibre intake, the favourable role of sufficient dietary low-digestible fibre (mainly lignin and cellulose) on rabbit digestive health has clearly been shown. However, a good dietary balance with more digestible fibre classes such as hemicelluloses and pectins is also favourable to reduce enteritis problems. In weanlings, excessive dietary protein content also reduces digestive health especially when it replaces fibre in the diet. Moreover, some protein sources contain antinutritive factors, such as lectins, antitrypsin or antigenic factors which could impair the digestion or induce changes in the morphology of intestinal mucosa leading to increased mortality. Another strategy which proved to be efficient even under infection pressure is a reduction of the feed intake level between 4 and 7 weeks of age. However, a reduction of 30% of the *ad-libitum* intake is necessary followed by a progressively increase of the feed intake level after the 3 weeks restriction period. Although some antibiotics have shown their efficacy in digestive trouble prevention, their use has been viewed critically because of their impact on the development of resistant bacteria that compromise human health. Alternatives are increasingly searched and used to disease control. Some of the candidate replacements for antibiotics such as probiotics, prebiotics, organic acids, plant extracts, enzymes and immune modulators have shown to have some potential in rabbit digestive trouble prevention.

Key words: feeding strategy, enteritis, rabbit.

MANAGEMENT OF RABBIT DOES IN SMALL AND MEDIUM SCALE RABBIT FARMS

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Management of rabbit does starts at their birth. The best selection strategy is to choose females from large litters with medium or high birth weight where the number of teats is 10. Selected kits should be nursed in medium or small litters in order to provide them with adequate milk supply. After weaning (or from 10-11 weeks of age), application of restricted feeding regime or consumption of pellet with higher fibre content is suggested to avoid their fast growth. In this case the first insemination can be delayed until an older age accompanied with a better maturity of the does. Before the first mating the receptivity can be increased with flushing (*ad libitum* feeding of pellet with high energy, protein etc.). Using double mating (either with the same or with different buck) the fertility will be higher. In the primiparous does, the number of kits kept in the litter has to be limited and a delayed remating is advantageous to avoid the negative energy balance (losing too much fat deposit).

Remating (reproductive rhythm) of the multiparous does depends on their feeding level. Applying controlled and free nursing for the primiparous and multiparous does, respectively the mortality of their kits can be reduced. Changing the free nursing of lactating does 2-3 d prior to mating - to controlled nursing the receptivity, fertility and litter size can be increased. Crossing different breeds yields some heterosis effect on reproductive traits (fertility, litter size, milk production, mortality of the kits). Increasing the daily illumination 7-8 d before mating (insemination) the receptivity and fertility can be increased. The optimal temperature for rabbit does is 16-18°C. Using different cooling systems or preventing the does from heat accumulation is advantageous avoiding low production level.

Key words: rabbit does, breeds, management, small and medium scale farms.

INDUSTRIALIZATION AND GLOBALIZATION OF ANIMAL AGRICULTURE: IMPLICATIONS FOR SMALL-AND-MEDIUM SCALE RABBIT PRODUCTION

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Potentials of small- and medium-scale rabbit farming will be compared to industrialized poultry production. Poultry production in most countries is now an industrial process. Poultry meat production in the United States is controlled by less than 10 vertically-integrated companies. The swine industry is also rapidly becoming industrialized. Critics refer to industrial animal production as "factory farming." There is increasingly a societal back-lash to what is perceived as factory farming. Major societal concerns are: (1) intensive animal production is inhumane and detrimental to animal welfare, (2) animal production is controlled by corporate interests rather than by family farmers, and is driven by profit motives rather than by ethical concerns for animal well-being, (3) intensive corporate animal production exploits workers, (4) modern animal production competes directly with grains used for human consumption, (5) diets containing animal products are unhealthy, causing degenerative diseases such as heart disease and cancer, (6) animal products are produced using antibiotics, hormones and other chemicals, resulting in food safety concerns, and (7) intensive animal production is harmful to the environment. In general, animal and poultry scientists are supportive of intensive, high-tech animal production, and have been responsible for much of the research which has led to technological innovations in animal agriculture. Intensive systems of animal production, largely a result of technological advances pioneered by animal and poultry scientists, have led to numerous animal welfare, food safety and environmental problems. Biotechnology has introduced further ethical issues, for example with cloning of animals. Animal scientists should be in the lead in addressing these problems and concerns. Rabbit production does not fit into the industrialized, globalized, corporate-controlled model, and may offer an alternative method of animal production more

acceptable to society, particularly in developing and emerging economies.

Key words: industrialization, small scale, medium scale, rabbit production.

FROM FOOD SECURITY TO HIGH QUALITY MEAT: ONLY ONE UNCONVENTIONAL SYSTEM

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Many years of cooperation with Developing Countries have led to study and test some unconventional (i.e. no building) keeping systems which had to obey to very strict conditions, being thought on behalf of very poor illiterate rural people. Main conditions were: easy structures made by the keeper himself with local freely available or low cost materials, efficiency to avoid heat stress, grass based feeding, no medical control of diseases. The same keeping systems proved later to be very fit to produce high quality meat. The most successful model is described. It is based on a small underground cell, easy to be inspected, closed by an insulated lid and connected by a tube to an external cage. The nest is set into the cell. Feeders and drinkers are mostly applied to the external cage. Each unit houses one doe or one buck. The surface is twice as much as the industrial cages. During the day, mainly in the hot season, rabbits, as in natural conditions, hide underground and get out to the cage in the late afternoon or when they like eating or drinking. Fatteners are housed in groups of three in open air cages, sheltered only by a roof. Open air and low density ensure a fair sanitary condition. Animal welfare is excellent and sanitary conditions are favoured by the microbial dispersion in the external environment. The breed Lepirino di Viterbo, that, as a part of the producing system, is the only one existing, specifically selected for open air keeping, is now pasteurized-free in all the small commercial units. No medicated industrial pelleted feeding is utilized and medical treatments are forbidden. High quality meat is produced. The excellence of production is till now assuring an income more than twice the commercial price. Some reproduction and production data are also reported.

Key words: food security, high quality meat, unconventional, system.

STRATEGIES AND EXPERIENCES IN SMALL RABBIT PRODUCTION

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Reflections and strategies for the small scale rabbit production are presented. The Tropical region of the world, where most of the developing and emergent countries are located, has a variety of different climates and orography, but meat rabbit production is still feasible. The use of forages is a realistic alternative to feed the

domestic rabbit in small scale rabbit production units, as has been documented in several communications.

Key words: strategy, small scale, production, rabbit, developing, emergent, countries.

SOCIO-ECONOMIC CONSIDERATION IN SMALL AND MEDIUM SCALE RABBIT FARMING

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Rabbit has some biological advantages over other animals because it can be bred at any time after reaching maturity, prolific, short calving interval, and rapid growth. In addition, the economic advantages of small and medium rabbit farming are (i) small capital investment and working capital; (ii) need small amount of land; (iii) utilize agricultural and industrial wastes; (iv) produce meat efficiently; and (v) produce multi-products: meat, skin and hides, fur, organic fertilizers, pet/fancy animal. Furthermore, rabbit meat matches with modern life style because it contains 20.8% protein, 10.2% fat, 7.3MJ/kg energy, low cholesterol and salt. Nevertheless, rabbit farming in Indonesia has some challenges, i.e. not all Indonesian prefer to consume rabbit meat and currently rabbit farming is not the main priority of the government. A national campaign for rabbit meat consumption has to be promoted to overcome this limitation. More creative product diversification is undergone in Indonesia to produce processed products such as sausages, nuggets, corned, meat ball, and burger. Further extension services for better good rabbit farming practices is also urgently needed. Social and economic analysis of small and medium rabbit farming shows that this activity can be a viable enterprise and thus it can be used as a vehicle for poverty reduction, improving nutritional status and reducing unemployment in rural and urban areas. Providing better quality breeds and feed, and controlling and eradication of some common diseases are among the main urgent steps in developing small and medium rabbit farming to be a sustainable and profitable rural occupation. To sum up, small and medium rabbit farming play an important role in the supply of domestic red meat, reducing unemployment rate in urban and rural areas, improving farmers' welfare in term of additional income and nutritious food. Small and medium rabbit farming can be a source of daily income for farm household from selling various products such as adult rabbit for slaughter, young and adult rabbit as pet animals, skin and fur for souvenir and handicraft and manure and urine as organic fertilizers. Integration of small and medium rabbit farming with other commodities, i.e. horticulture, food crops, forest plants nursery and fish farming can benefit from organic fertilizer from rabbit, while plenty of agricultural wastes can be fed to rabbit. This integration may increase production both from rabbit and crop farming, and reduce agricultural residues into a "zero waste" system.

Key words: socio economic, small scale, medium-scale, rabbit.

COMMUNICATIONS

EFFECT OF FEEDING *MORINGA OLEIFERA* TREE LEAVES ON BLOOD PARAMETERS IN BROILER RABBITS

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Many of the population studies have linked increased concentration of total cholesterol or Low density lipid (LDL) in plasma with increased incidence of atherosclerotic events. In India the leaves of *Moringa Oleifera* leaves are claimed to possess cholesterol reducing effect and are being used to treat patient with heart disease and obesity. *Moringa Oleifera* is a leguminous forage tree and it can be a good unconventional feed supplement for animals. The present study was conducted to evaluate the effects of feeding *Moringa oleifera* tree leaves at different periods of time on certain haematological such as haemoglobin concentration and serum parameters such as Total serum protein, Serum total cholesterol, Serum triglycerides, and serum glucose concentration. During the feeding trial of *Moringa Oleifera* tree leaves, the mean serum total cholesterol concentration ranged between 84.25+3.17 and 117.30+1.55 and the serum glucose concentration was significantly reduced at 10% level feeding of *Moringa Oleifera* leaves. The decrease in serum total cholesterol and decrease in serum glucose concentrations might be due to the presence of β -sitosterol which has the cholesterol lowering or hypolipidaemic effect by the inhibition in reabsorption of cholesterol from endogenous sources and with simultaneous excretion through feces in the form of natural steroids and the inclusion of *Moringa oleifera* leaves in feed had an and antihyperglycemic or hypoglycemic effect respectively in broiler rabbits.

Key words: *Moringa oleifera*, blood parameters, Broiler rabbits.

EFFECT OF SUNFLOWER OIL AND LINSEED OIL AND VITAMIN E DIETARY SUPPLEMENTATION ON GROWING AND SLAUGHTER PERFORMANCE OF RABBITS

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As part of a trial on improving the fatty acid profile and oxidative stability of rabbit meat, this work studied the effects of source and level of vitamin E dietary

supplementation on growth and carcass traits in NZW rabbits (n=300). The negative control group (NC) was fed a low energy diet (10.6 MJ/kg DE) without oil addition and with 60 mg/kg synthetic vitamin E (dl- α -tocopherol-acetate) from 21 to 84 d of age. The positive control group (PC) received a higher energy diet (11.4 MJ/kg DE) with 2% sunflower oil and 2% linseed oil and 60 mg/kg synthetic vitamin E. In 150-ES and 300-ES groups the levels of synthetic vitamin E were increased to 150 and 300 mg/kg feed, respectively. In 90-EN and 240-EN groups 60 mg/kg synthetic plus 90 and 240 mg/kg natural vitamin E (a fatty acid distillate, i.e. d- α -tocopherol) were used to reach the 150 and 300 mg/kg vitamin E doses, respectively. Except in the NC group, the energy and oil contents of the diets were similar. Compared to NC rabbits, the 35 d body weight was the same for 150-ES young but it was lower for the PC, 300-ES and 90-EN rabbits. The 240-EN kits had the lowest 35 d weaning weight which significantly differed from NC and 150-ES rabbits (914, 886, 892, 887, 883, 863 g, $P=0.011$ for the NC, PC, 150-ES, 300-ES, 90-EN, 240-EN groups, respectively). At 84 d of age, however, the 300-ES and 240-ES rabbits had identical and higher body weights than NC rabbits. The 84 d live weights of PC, 150-ES and 90-EN rabbits did not differ significantly from the other groups (2594, 2655, 2688, 2745, 2687, 2733 g, respectively $P=0.049$). Compared to NC rabbits, feed conversion was significantly better for the other rabbits (3.29, 3.12, 3.03, 3.05, 3.05, 3.02, respectively $P=0.001$). Dressing out percentages (63.1, 64.9, 64.4, 63.4, 63.1, 63.7, respectively $P=0.001$) were significantly higher for PC and 150-ES than for NC, 300-ES and 90-EN rabbits. The value for 240-EN rabbits was moderate and differed significantly only from PC rabbits. Based on these results a 150 mg/kg synthetic vitamin E dietary addition is recommended. The inclusion of a higher dose with a partly natural source, i.e. 240 mg/kg natural vitamin E is also possible, if it significantly enhances the vitamin E content and the oxidative stability of the meat.

Key words: sunflower oil, linseed oil, vitamin E, growth, carcass.

YUCCA SCHIDIGERA AND QUILLAJA SAPONARIA PRODUCTS AS FEED ADDITIVES FOR RABBITS

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Yucca schidigera and *Quillaja saponaria*, native to Mexico and Chile, respectively, are the two major commercial sources of saponins. Some of the properties of extracts or whole plant powders of yucca and quillaja include: control of odor and ammonia in livestock and poultry houses; anti-protozoal activity; nematocidal activity; cholesterol-lowering properties; reproductive effects; anti-inflammatory activity, and growth-promotant activity. In addition to saponins, yucca contains resveratrol, polyphenolics (yuccaols), and oligosaccharides. Quillaja contains polyphenolics and oligosaccharides. Quillaja saponins have immunostimulatory properties and are used as adjuvants in veterinary vaccines. Quillaja and yucca products reduce incidence of stillbirths in litter-bearing

animals. The properties of yucca and quillaja products, and potentials for their specific application in rabbit production, will be discussed.

Key words: *Yucca schidigera*, *Quillaja saponaria*, feed additives, rabbits.

GENETIC ANALYSIS OF RABBIT REPRODUCTIVE TRAITS AT PRE-WEANING, WEANING AND POST-WEANING IN THE HUMID TROPICS

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Performance data of eight rabbit genotypes from a breeding experiment conducted at Rabbit Unit of Teaching and Research Farm, Federal University of Technology, Akure Nigeria between 1998 and 2001 were analyzed to estimate heritability and repeatability. The heritability estimates for individual kit weights at birth and at 21, 35 and 56 d of age varied from 0.068 ± 0.14 at 21 d to 1.08 ± 0.40 at 56 d. High estimates of 0.44 ± 0.22 and 0.49 ± 0.27 were obtained at birth and 35 d respectively. The repeatability estimates for individual kit weight varied from 0.018 ± 0.048 to 0.37 ± 0.048 . The moderate estimate of 0.37 ± 0.048 was observed at 56 d. This showed that genetic progress could be made through selection for weights at 35 and 56 d of age.

Key words: genetic, parameters, rabbit, ages.

MILK PRODUCTION IN RABBITS: QUANTITY AND QUALITY

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Rabbit kits are until 18-19 d of age exclusively depending from the milk of their mother. Therefore early liveability and growth performances are closely related to the quantity and quality of the milk ingested. This review focuses on the milk yield and milk composition of rabbit does and the main influencing factors. There are different ways to quantify the milk yield of rabbits. Although possible, mechanical or manual milking is not a usual and practical method to measure milk production. An accurate indirect method is to weigh the female before and after the once a d nursing event. However, also the weight gain of the litter between birth and the age of 3 weeks is a very good estimate ($r \geq 0.9$) of the milk yield during that period. Actual highly efficient hybrid does have, under favourable housing and feeding conditions, an average daily milk yield of 250 g or 60 g/kg of live weight during the 4-weeks lactation period. Native breeds under less favourable conditions have a milk yield of 100-150g/d or 30-40 g/kg live weight. However, compared with cow and sow milk, rabbit's milk is much more concentrated in fat (12.9 g/100 g), protein (12.3 g/100 g) and energy (8.4 MJ/kg) which explains the extremely rapid growth of the young (weight $\times 6$ after 3 weeks). Characteristic of rabbit milk is also the nearly absence of lactose (< 2 g/100 g). At peak lactation, protein output per kg metabolic weight (13.4 g/d/kg^{0.75}) exceeds even those of Holstein milk

cows. The non-nutritional factors having the largest impact on the milk yield are the number of suckling kits, the parity order (primiparous vs multiparous), the breed and the gestation overlapping degree (rapid decline after 17-20 d of gestation). However, also through the reduction of feed intake, heat stress has a detrimental impact especially when the night temperature remains above 25°C. Rabbit milk lipids are highly saturated (70.4% SFA) due to the high content of C_{8,0} - C_{12,0} (50% of total FA) and further characterised by nearly equal quantities of oleic and linoleic acid and an ω -6/ ω -3 ratio around 4. Finally some data about the amino acid, milk proteins including the immunoglobulins, mineral and vitamin composition are presented.

Key words: milk production, rabbit.

PAST AND PRESENT RESEARCH ON RABBIT PRODUCTION AT THE INDONESIAN RESEARCH INSTITUTE FOR ANIMAL PRODUCTION

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Since the introduction and widespread distribution of rabbits in the 1980s, rabbit has become an interest for research in Indonesia. However, since rabbit is not considered as a high priority animal to be developed, its research funds, hence, numbers of its researches are limited. Researches were mainly dealt with forage and by-product feeds utilization for meat production. In the late 80s, when Rex and Satin were introduced, researches were redirected to the production of quality fur including the tanning process. In the late 90s and early 2000s, successful attempt was achieved to produce a breed of rabbit that has Rex-Satin like-fur (named as Reza), ie soft, uniform and shiny fur. This breed (Reza) however, is susceptible to enteritis and rather slow in growth. In the last three-four years, the interest of farming rabbits in various areas, although at very small scale farming (5 – 20 does), increases tremendously. This increase interest may partly be caused of the widespread of Avian Influenza and rabbit farming become an alternative for family who used to be raising local chicken. Problems faced by rabbit farmers are quality of breeding stock, expensive premixed diet, availability of good quality forages and enteritis. Mortality of 20 -40% prior to and 4 weeks after weaning often occurs with the rabbit in small scale farming. Currently, research is directed to have productive Rex, Satin, Reza and produce a medium-big size Reza, reduce mortality through nutrition and possible use of some herbs known to prevent diarrhoea and improve village rabbit management.

Key words: rabbit, research, Indonesia.

POTENTIAL AND PROSPECT OF SMALL AND MEDIUM SCALE RABBIT INDUSTRY IN INDONESIA

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Potential of rabbits as meat-producing animal is well known, and it was since the 1980s rabbit has been widely introduced and farmed in Indonesia. Initially, aim of this farming was to increase meat consumption of the families in the villages, and a to lesser extent, in the vegetable production areas, is to obtain manure. Nowad, however, farming rabbits in some areas have become a significant source of income. Interest in raising rabbit is growing fastly in the last two years, which partly may be due to the incidence of widespread Avian Influenza. In the vegetable production areas, such as Brastagi (North Sumatera), Lembang and Pengalengan (West Java), Magelang (Central Java), Malang (East Java) and Bedugul (Bali) the potential of rabbit development is great. Depending on the area, rabbits are marketed mostly for pet and weanlings (for breeder and fryer stock) and for meat. There is also small demand for fur and laboratory animals. As small animal, yet high in productivity, together with market availability and low input capital, farming rabbits are prospective for small and medium scale operation. In a simple economic analyses, the B/C ratio of raising 100 does and 10 bucks with or without forage supplementation are 1.42 and 1.74 for meat production, 1.79 and 2.40 for meat and fur production, 1.80 and 3.55 for pet production, respectively, and 3.10 for laboratory animal production without forage supplementation. Processing of rabbit meat to produce frankfurter, corned meat, meat ball, burger or 'nugget' may increase the profit by 40 – 120%. Attempts to promote and/or to drive demand for rabbit, and some other areas where rabbit raising is found in Indonesia, including in Papua, is presented.

Key words: potential, prospect, rabbit.

POSTERS

ENVIRONMENT – IT'S ROLE IN RABBIT MANAGEMENT

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Rabbit rearing for meat is comparatively a newer concept. Various advantageous of rabbit rearing are less capital investment, minimum housing, high reproductive efficiency/prolificacy, efficient feed and land space utilization, no apparent competition with human for the same foods, moreover no religious taboos affecting the consumption of rabbit meat makes them very congenial to be reared in a highly commercialized enterprise as well as on a small scale or back yard level with minimum inputs by feeding forages, vegetables

and household wastes. Environment is a prime limiting factor in animal production, It has both immediate as well as long-term adaptive influences on rabbits. The environmental factors like ambient temperature, RH, solar radiation, wind velocity, light and noise are important factors affecting rabbits comfort and performance through their effects on physiological mechanisms. The extent to which the performance is influenced by the above factors is of great relevance to particularly the fur bearing animals like rabbits, sheep, goat.

Key words: environment, magement, rabbit.

EFFECT OF CROSSBREEDING ON REPRODUCTIVE PERFORMANCE IN RABBITS

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A crossbreeding experiment was carried out to evaluate the reproductive performance of purebred and crossbred rabbit does. Data of purebred Pannon White (PW, 195 litters), Maternal line (ML, 155 litters) and that of their diallel crossbred does (ML♂×PW♀, 166 litters, PW♂+ML♀, 173 litters) were compared. The conception rate of the four genotypes was similar (77.5-79.4%). The effect of genotype on body weight of does at parturition (PW:4.30 kg, ML:4.05 kg, MLPW:4.16 kg, PWML: 4.16 kg, $P<0.001$) and on number of kits born alive (NBA) (PW:7.88, ML:8.19, MLPW:8.38, PWML:8.91, $P<0.05$) was significant. On the contrary differences in total number of kits born (TNB) were not significant (PW:8.44, ML:9.04, MLPW:9.29, PWML: 9.61, $P=0.125$). The size of the heterosis in TNB and NBA alive was 5.7 and 7.6%, respectively. After equalization of litter size for 8.03-8.33 in each genotypes no heterosis was found in litter size and litter weight at 21 d of age. The best crossing combination was PW♂×ML♀.

Key words: rabbits, purebreeding, crossbreeding, reproductive performance.

PRELIMINARY STUDY ON THE USE OF PALM KERNEL MEAL IN RABBIT FEED

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The increasing palm oil industry in Indonesia has created the idea of utilizing palm oil factory by- product. The palm kernel meal (PKM) is one of its by-product that could be utilized as livestock feed. The limitation of PKM in diet for monogastric animals or poultry is its high fiber content. On the other hand, rabbit needs high level of indigestible dietary fiber, hence may suit the use of this PKM. In addition, rabbit may also be an alternative for a good and healthy meat in place of poultry, which suffers from bird flu.. However, one of the drawback of intensive rabbit industry is diarrhoea, which could partly

be caused by the short of dietary fiber. Thirty six young rabbits of Rex and Satin strains weighed from 700 to 1000 g/head were randomly allocated to four dietary rations containing 0, 5, 10 or 20% PKM. Diets were isoenergy, isoprotein and isofiber content. Rabbits were confined in wire cages provided with pelleted feed and water *ad libitum*. The observation was conducted for 8 weeks. The average weight gains of rabbit in g/head/8 weeks were 1072 (±85), 1053(± 295), 832 (±21) and 945 (± 110), respectively for treatment 0, 5, 10 and 20% dietary PKM. Feed consumption during the observation (8 weeks) were 5025 (±252), 4900 (± 657), 4478 (± 472), and 4625 (± 346), whilst the feed conversion ratios were 4.75 (± 0.39), 4.80 (± 0.82), 5.38 (±0.55), and 4.91 (±0.21), and the average values of organic matter digestibility (%) were 68.38 (± 1.06), 44.59 (± 0.91), 63.16 (± 1.34), and 56.97 (± 0.05), respectively for treatment 0, 5, 10 and 20% dietary PKM. Mortality was 2, 1, 0, and 1 out of 9 rabbits for treatment 1, 2, 3 and 4 respectively. The variation in of growth response and digestibility of organic matter to levels of PKM will be discussed in the body text.

Key words: Palm kernel meal, young rabbit growth rate, organic matter digestibility

RABBIT HUSBANDRY PROFILE IN MAGELANG

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Magelang district is one of the rabbit production centre area in Central Java Province. Starting in 2007, survey was conducted in Magelang to collect data finding the model rabbit husbandry profile. Primary data were collected from rabbit farmers. Results indicated that in term of education, from the total farmers interviewed, 45% has high school background, 20% were from D-3, and 5% were from S-1. This results was rather unusual in animal production farming, as most farmers deal with animal production were those in the primary school education background. About 73% of the respondents started their rabbit farming within the last 3 years. Twentyone percent have raised rabbits 4 to 9 years ago, and only 6% have been raising rabbits more than 14 years. Aim of raising rabbits are to produce as much animals as possible for meat or fur at the lowest possible cost. Number of rabbit kept per household varies; 48% farmers raise 1-9 does, 48% raise 10-30 does and only 4% from the total farmers interviewed have more than 30 does. Individual battery system is mostly chosen as the model for rabbit cages. Both local breed and Flemish Giant are raised. Rabbits were fed greens, vegetables, kitchen waste or any other farmer-supplied feed. Simple economic analyses on the cost and revenue indicates an R/C value of 2,7. Farmers can sell rabbit's product directly to consumers, traditional market or to rabbit brokers. The rabbit production problems are diseases; high price for breeding does and the low availability of concentrate feed and medicine.

Key words: rabbit husbandry, husbandry profile, R/C, scale.

EFFECT OF DETANNICATION OF *CALLIANDRA CALOTHYRSUS* ON DIGESTIBILITY AND PERFORMANCE OF RABBIT

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Although the protein level is high, *Calliandra calothyrsus* also contained high level of tannin. This experiment aimed to study the effect of reducing the tannin content in *C. calothyrsus* on digestibility and performance of rabbit. Polyethylene glycol (PEG) and lime were used to detannified or reduce tannin content in calliandra. one feeding trial was conducted using 27 New Zealand White rabbits raised individually in wire cage and allocated into 3 dietary treatments contained 30% of : 1) calliandra leaf meal (untreated), 2) PEG treated calliandra leaf meal and 3) lime treated calliandra leaf meal. Feed consumption and body weight were recorded for 6 weeks. There was no statistical difference on daily consumption among treatments, however, a significant improvement ($P < 0.05$) on daily gain was obtained by PEG and lime treatments compared to untreated treatment (26.62 and 26.35 g/d vs 24.04g/d, respectively). A digestibility trial was conducted using 6 Rex rabbits raised in metabolism cage individually. Rabbits were fed with 1) fresh calliandra, 2) PEG treated calliandra and 3) lime treated calliandra as a sole diet. After a week of feeding, faeces were collected for 7 d. At the end of experiment, all rabbits were slaughtered and the contents of digestive tract compartment were collected and analysed. Detannification treatments by PEG and lime increased dry matter, protein, NDF and NDF-bound protein digestibilities ($P < 0.05$). PEG not lime treatment reduced protein and NDF-bound protein level in the digestive tract compartments of rabbit. In conclusion, detannification of *Calliandra calothyrsus* by PEG or lime improved digestibility and performance of rabbit.

Key words: detannification, PEG, lime, *Calliandra calothyrsus*, rabbit.

FEEDING VALUE OF FRESH AND DRIED *CALLIANDRA CALOTHYRSUS* FOR RABBITS

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Calliandra calothyrsus is a leguminous tree widely grown in Indonesia and has protein content of 25% and can be valuable as rabbits feed. Two feeding trials have been conducted to evaluate different levels of fresh (0, 15, 30 and 45%) and dried (0, 15 and 30%) calliandra leaves for growing rabbits at initial body weight 730-860 g. The dietary treatments were formulated in such way to meet nutrient requirement of growing rabbits and were fed to rabbits raised in the individual wire cage and replicated 8 times. Fresh calliandra leaves was readily consumed by rabbits. Rabbits fed fresh Calliandra leaves grew at rate of 15-19 g/d and there was no difference on the daily gain and feed/gain ration due to the treatments. Feeding of Calliandra

leaf meal up to 30% in the diet also did not affect the growth rate of rabbits with average daily gain at 19-21 g/d. A digestibility trial has been conducted to measure the effect of wilting of Calliandra leaf using collared rabbits to prevent coprophagy raised in metabolism cages. Dry matter digestibility of fresh calliandra was 50.0% and was found no statistical difference with wilted calliandra (44.7%). There was a significant effect of wilting on neutral detergent fiber digestibility (NDF) and protein bound NDF but not on total protein. NDF digestibility decreased from 24% in fresh leaves to 2.4% in wilted leaves. Prevention of coprophagy on rabbit resulted in decrease on dry matter, protein, fiber and protein bound fiber digestibility. Extractable tannin digestibility measured by vanillin and protein precipitation techniques showed that the tannin was almost completely (97-98%) digested by rabbits. In conclusion, calliandra leaves both fresh and dried can be fed to rabbits up to 45% and 30%, respectively and the fiber component in calliandra is less digested when the leaves was wilted.

Key words: *Calliandra calothyrsus*, feeding value, drying, wilting, rabbit, digestibility.

A CONCEPT OF OPEN NUCLEUS BREEDING SYSTEM TO PRODUCE SUSTAINABLE RABBIT PRODUCTION IN INDONESIA

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Rabbit farming is one of the alternative rural rearing after the widespread of bird flu to the local chicken in Indonesia. However, the quality of the breed and sustainability of production must be controlled by the community-based stakeholder and -farmers. A community-based project on improving and sustaining self-sufficiency food through promoting integration, multiplication and intensified utilization of diversity of rural rabbit has been initiated in villages in Magelang. The concept is expected to be operational through an open nucleus breeding system established in rural communities and managed by a group of farmers. The farmers and other community-based stakeholders are fully involved in all aspects and the group committee make all decision. IRIAP (Indonesian Institute for Animal Production) as a nucleus-breeding centre located at Ciawi-Bogor, and breeder farmers as multipliers in Magelang are established. IRIAP distributed selected rabbits to Multiplier (breeder farmers) and breeder farmers, within the community multiply and distribute breeding stock to other farmers. Different breeds of rabbit (NZW, FG, and their crosses with Rex, Satin or Reza) will be raised and their performance is evaluated by the centre. Rabbits that have above average performance will be selected for further breeding stock. Group committee and breeder farmers are trained on rural rabbit breeding management. This 'open nucleus breeding system concept' is aimed at increasing flock size and flock integration among rural farmers, improving rabbit productivity through selection and evaluation, reducing meanlings mortality and improving

nutritional status and social economic of farmers in the rural community.

Key words: rabbit, open nucleus breeding system, rural communities.

EFFECT OF CROSSBREEDING OF FLEMISH GIANT BUCKS WITH VARIOUS BREEDS OF DOES ON THE PERFORMANCE OF CROSSBRED KITS

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A preliminary experiment was carried out to study the effect of crossbreeding of Flemish Giant (FG) bucks to different doe breeds on growth performance of crossbred kits. Data were collected from 239 kits (F-1) born from first-parity of 45 does consisted of 10 Reza, 9 purebred New Zealand White (NZW), 15 local NZW, 6 purebred FG and 5 crossed FG. All does were mated to 5 purebred Flemish Giant bucks randomly. All animals were kept under the same management. Parameters observed were litter size (LS) and litter weight (LW) at birth, 14 d-old and at weaning, mortalitas at 14 d and at weaning, feed consumption and feed efficiency. Data were analysed using PROC GLM (SAS, 2001) with PDIFF for comparison test among breeds of does. Results showed there were significantly differences ($P < 0.05$) in litter performance at birth and weaning due to breed effect of does.

Key words: crossbred, growth traits, doe effects, does.

EVALUATION OF MORPHOMETRIC CHARACTERISTIC AND ESTIMATION OF MAHALANOBIS GENETIC DISTANCE OF RABBIT FROM IRIAP

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The observation on morphological body conformation of New Zealand White (NZW), Rex (RR), Satin (SS) and Rex × Satin (RS) from Balitnak-Ciawi (IRIAP), were carried out to determine estimation of Mahalanobis genetic distance and discriminant analysis. The research was done at RIAP, Bogor, using 23 NZW, 25 RR, 22 F SS and 21 RS rabbits. Length of head, width of head, length of ear, width of ear, circumference of chest, depth of chest, width of chest, length of scapula, length of humerus, length of radius-ulna, length of tibia, length of body and width of hip were measured to observe their body size. Data obtained were analyzed by using GLM (General Linear Models) and simple discriminant analysis with SAS package program version 6.12 (SAS, 1985) and program MEGA2 (Kumar et al., 2001) to make the construction of tree fenograms. NZW rabbits had larger body size (i.e. length of head, ear, radius-ulna, and tibia, and also width of hip) than RS rabbits. Mahalanobis genetic distance showed that NZW with RR, SS and RS had a genetic distance of 2.084159,

2.986475 and 3.747641, respectively. RR with SS and RS had a genetic distance of 2.584121 and 3.308619. SS and RS had a genetic distance of 2.785891. Results from canonical analysis showed that the most discriminant variables were obtained from length of radius-ulna, length of tibia and width of hip. Genetic distance and discriminant analysis conformed to the fact that NZW, Rex and Satin rabbits and development of Rex × Satin rabbit at RIAP was improved through selection and crossing.

Key words: rabbit, mahalanobis genetic distance, morphometric.

FERMENTATION PRODUCT OF CASSAVA WASTE FOR RABBIT FEED

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Cassava waste (onggok) products is abundantly available in Indonesia and has become a problem to the environment for quite sometime. This waste product is rich in digestible and indigestible fiber content and has been used for ruminant feed. Its protein content, however, is very low (1.1%). Enrichment of protein content could be done through fermentation using *Aspergillus niger*. Furthermore, enzymes (cellulase and amylase) in the fermentation product could be useful to increase feed digestibility. An experiment was carried out to enrich cassava waste through fermentation with the *Aspergillus niger*. Results showed that enzyme activity was 38.35 and 189.15 U/g DM product for cellulase (CMC-ase) and amylase respectively. Fermentation increased protein content from 1.3 to 14.6%, crude fiber from 11.4 to 20.0%, ADF from 16.6 to 28.6% and lignin from 2.6 to 4.2%, and decreased NDF content from 39.7 to 33.2% and gross energy from 15.6 to 14.6 MJ/kg. Inclusion of fermented product up to 10 and 20% in rabbit diet gave the live body weight at 12 weeks-old 1951 and 1900 g, respectively, higher than control (1468 g). Fermented product of cassava waste can be used as protein source in rabbit diet.

Key words: fermentation, cassava, rabbit.

POSSIBILITY OF CREATING SHINY FINE HAIR RABBIT

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The aim of this study was to know the possibility of creating shiny fine hair rabbit by combining fine hair trait from Rex rabbit (H) and shiny hair trait from Satin rabbit (K). The material used was F-2, the offspring of the crossed of the Rex rabbit male and the Satin rabbit female (F1-HK) as well as the offspring of the reciprocal (F1-KH) which mated interse became F2-HKHK and F2-KHKH, and the crossed became F2-HKHKH and F2-KHHK. Quantitative and qualitative approaches were adopted in this study. To know that the shiny and the fine hair traits could be combined, all of the F2 (425 heads) of four weeks old were observed. Each type of the F2 were grouped according to the hair condition by macroscopic observation (touching and looking at the hair) using a definite standard. Hair samples

from rabbits having shiny-fine hair, its were observed microscopically. To determine that the Mendel Law worked in the F₂, a Chi square test was used. Result of the experiment showed that rabbits having fine and shiny hair could be formed in the second generation of crossing Rex and Satin rabbits. Mendel law did not work in the F₂.

Key words: Shiny fine hair, crossbreeding, Rex rabbit, Satin rabbit.

THE GROWTH OF REX RABBIT HAIR

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Forty Rex rabbits, 40 Satin rabbits, 40 Rex-Satin cross, and 40 Satin-Rex cross were used to study the growth characteristic of the rabbit hair. This study was carried out at the Indonesian Research Institute for Animal Production, Ciawi-Bogor. The rabbits were kept indoors in Quonset-style wire cages, fed commercial diet containing 22% crude protein and 2750 kcal/kg. Hair samples were taken from all rabbits at a certain location, i.e. At medio dorsalis of the vertebrae lumbalis. This study used two methods. The qualitative method was used to identify the hair growth cycle and the hair growth pattern. The quantitative method was used to study the hair growth by measuring the hair length, diameter, density and weight at the age of 4, 8, 12, 16 and 20 weeks. The hair characteristics were guard hair to down hair length ratio, the hair growth angle from the body surface and the hair softness. Guard hair observation was started when rabbits were on one d of age. The hair started to grow on the 3rd d. The hair growth was cyclical. The baby prime cycle occurred from birth and stopped in 10 weeks of age. The intermediate prime cycle started in 11 weeks of age and terminated in 20 weeks of age. The senior prime cycle started in 21 weeks of age. There was no significant different in the maximum hair length in the baby, intermediate and the senior prime cycle. In the intermediate prime cycle, the hair had already in the maximum length in the first second week (19.26±2.46 mm for down hair and 19.54±2.33 mm for guard hairs). In any cycle, there was a tendency that at the beginning of a prime cycle the average hair diameter was larger than that of the later. The guard and the down hair density increase within the baby or the intermediate prime cycle. The hairs, down and guard hair, were more dense at the intermediate prime cycle than in the baby prime cycle. In the baby prime cycle, the down and the guard hair grew proportionally. In the intermediate prime cycle, however, the guard hairs tend to grow more than the down hairs. In any cycle, the hair weight per cm² increased as the hair density increased. The average hair weight per piece, however, decreased as the hair density increased. The guard to down hair length ratio was 1:1. The Rex rabbit guard hair diameter was much smaller than that of the non-Rex rabbits. The type of Rex rabbit hair cuticles was wave type, which supported the hair softness.

Key words: Rex rabbit, hair, growth.

EFFECT OF INCLUSION OF ANIMAL PROTEIN SOURCE IN RABBIT RATION ON THE PHYSICAL QUALITY OF PELT

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Pelt's quality is very important to determine fur production. Pelt quality is predicted to be influenced by type of ingredient composing ration, for example by animal protein source. Aim of this research is to study the effect of dietary animal protein source on rabbit pelt quality. A Completely Randomized Design (CRD) applying New Zealand White cross rabbits was used in three dietary treatments consisting of 6 rabbit each. Dietary treatments were (i) no animal protein source, (ii) protein from *Thunnus albacares* wasted meal and (iii) protein from *Lumbricus rubellus* meal. Physical quality measurements were made on stretching strength, tensile strength, and tearing resistance. Results showed that pelt from rabbit consuming diet containing *Lumbricus rubellus* meal had the highest stretching strength, tensile strength, and tearing resistance ($P < 0, 05$) compared with those from other treatments. Physical quality of pelts from rabbits fed *Thunnus albacares* wasted meal was not significant from those fed without animal protein.

Key words: protein, pelt, rabbit.

THE DIGESTIBILITY OF DRY MATTER, ORGANIC MATTER AND CRUDE PROTEIN OF PALM KERNEL CAKE IN RABBIT

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The research was conducted on August until September 2006 at rabbit laboratory, Faculty of Animal Husbandry, Univeristy of Padjadjaran, Jatiningor-Sumedang. The purpose of this research was to study the inclusion of palm kernel cake (PKC) level in the ration on digestibility of dry matter, organic matter and crude protein in rabbit. A fully randomized design applying 24 NZW rabbits of 8 months-old was used. Treatments were R0 = ration without PKC, R1 = ration with 10% PKC, R2 = ration with 20% PKC, and R3 = ration with 30% PKC. Replicates were 6 individual rabbit per treatment. Results showed that inclusion of PKC in the diet did not have significant effect on the digestibility of dry matter, organic matter and crude protein in the rabbits. Inclusion of PKC up to 30% in the ration had similar digestibility values with those from diet without PKC.

Key words: palm kernel cake, ration, digestibility, rabbit.

EFFECT OF DIETARY LEVEL OF CASSAVA FLOUR ON THE PHYSICAL CHARACTERISTIC AND ACCEPTABILITY OF RABBIT MEATBALL

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Meatball is a processed meat product which is popular in any levels of society. The main ingredient of the product is commonly from beef, but it is possible to use rabbit meat. In the process of meatball production, a filler (a type of ingredient) is needed to get cohesive, plasticity and round product, and to reduce shrinkage of the product. Aim of the research is to get an appropriate level of meal that could produce good physical characteristic of the meatball. Three levels of cassava meal (10%, 15% and 20%) was used in a complete randomized design (CRD) experiment. Each treatment consisted of 6 individual replicates. Observation on the physical characteristic included hardness, water holding capacity and cooking losses, while acceptability is including taste and elasticity. Results showed that increasing levels of cassava meal from 10%, 15% to 20% did not effect elasticity and water holding capacity, but did not reduce cooking losses of the rabbit meatball. The preference on taste and on elasticity of meatball with various level of using cassava meal were not different. It is concluded that inclusion of 20% cassava meal as filler could produce good physical quality meat ball.

Key words: meatball, cassava, rabbit.

THE EFFECT OF VARIOUS DIETARY FIBER LEVELS ON MEAT QUALITY FROM LEG AND LOIN PART

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Fiber in the diet should be carefully examined as rabbit has limited ability in digesting fiber. Dietary fiber content affects body fat content, hence it will also affect meat tenderness. Meat tenderness varies depending on parts if the body (loin, thigh, etc), which is influenced by tissue content. A factorial design applying 4×2 treatments in an Randomized Block Design (RBD) experiment was conducted to study the effect various dietary fiber levels on the tenderness of meat from leg and loin. First factor were dietary fiber levels (12%; 13%; 14%; and 15%), while the second were carcass part, the leg and the loin. Each treatment had 6 replications, hence a total of 48 male rabbits were used. Measurements were pH, water holding capacity and tenderness of the meat. Results showed that the loin has higher tenderness and water holding capacity values ($P < 0, 05$) compared with those from the leg. Meat pH, however, was not affected. Fiber levels did not affect all measurements. There was no interaction between the two factors either.

Key words: tenderness, meat, fiber.

APPARENT NUTRIENT DIGESTIBILITY OF RABBITS FED DIETS CONTAINING KAPOK-SEED MEAL (*CEIBA PETANDRA GAERTNER*)

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An experiment was performed to determine the apparent digestibility of nitrogen (ADN) of rabbits given diets containing kapok seed meal (KSM). The present study used 24 male New Zealand White rabbits of 12 week-old (1416 g initial live weight). The experimental animals were housed randomly in the individual wire-mesh cages, and allotted into four experimental diets. The experimental diets were 0 KSM (Diet₁), 5% KSM (Diet₂), 10% KSM (Diet₃), or 15% KSM (Diet₄), and offered *ad libitum* to the rabbits in pellet form. Measurements were made for apparent digestibility of dry matter (ADDM), ADN, crude fibre (ADCF), and energy (ADE). Results showed that there was no significant different between ADN of rabbit consumed Diet-1 and Diet-2 (76% and 75%, respectively). However, ADN of the Diet-3 (72%) and Diet-4 (72%) were lower ($P < 0.05$) than those from Diet-1 and Diet-2. It was possible that inclusion of 10% KSM in the diet already exhibited the deleterious effect of the cyclopropanoid fatty acid of such feedstuff. Consequently, inclusion of 15% KSM in the diet also lowered nitrogen digestibility in rabbits. Furthermore, the present experiment determined similar ADDM (55.7 – 60%), ADCF (14.2-15.3%), and ADE (57.2-61.8%) among the four experimental diets. Overall, inclusion of 5% KSM in the diet for rabbit was obviously saved.

Key words: rabbit, apparent, faecal digestibility, nitrogen, kapok seed meal.

CORRELATION BETWEEN THE LIVE WEIGHT OF DOE AND LITTER PERFORMANCE OF LOCAL FLEMISH GIANT RABBITS

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The present study was conducted to investigate the correlation between rabbits does live weight (DLW) and their litter performance. The study applied 28 six month-old females (initial live weight of 2600 g to 3650 g) and seven bucks (3126 g average live weight) local Flemish Giant rabbits. The experimental animals were housed individually in the wire-mesh cages, fed diet containing 14% crude protein, 13.4% fat, 22.9% acid detergent fibre, and 10.3 MJ DE/kg. Diet was offered to the rabbits *ad libitum*, and water was available throughout the experimental period. When oestrus occurred, each doe was taken into the buck room to

breed. Measurements were conducted for litter size and weight. Results showed that there was no significant correlation between the LW of doe and either litter size or litter weight. The correlation coefficient (r) of DLW and litter size (LZ) was 0.1579 ($DLW = 2.919 + 0.00104 LZ$). While its correlation coefficient to the litter weight (LW) was 0.1958 ($DLW = 110.313 + 0.0518 LW$). However, the correlation between LZ and LW (0.724) was significant ($P < 0.01$; $LZ = 92.776 + 29.059 LW$). Consistently, there was a significant correlation (-0.6279 ; $P < 0.01$) between LZ and average birth weight (ABW) of the kids ($LZ = 68.435 + 3.586 ABW$). The conclusion of the present study is that there was no correlation between live weight of doe and litter performance of Flemish Giant rabbits. The investigation confirmed that the larger litter size, the smaller average birth weight of new born rabbits

Key words: rabbit, correlation, live weight of doe, litter size, litter weight.

PERSPECTIVE OF RABBITS POPULATION DEVELOPMENT IN CENTRAL JAVA

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Since the year of 2003, the avian influenza virus epidemic has depressed chicken meat and egg production in Indonesia very badly. Whereas in fact poultry products are the most affordable animal protein resources for low income society. Therefore, people pay attention to obtain other source of animal protein to meet their requirement. As a result, beside fresh water fishes, rabbit meat is considered as an available protein alternative in Central Java. The present study is aimed to evaluate the perspective of rabbit population development in Central Java. The primary data was collected through a rapid survey in Semarang and Temanggung Districts, while the secondary data was provided by the office of Livestock Services of Central Java. Results showed that currently village rabbit farmings are growing sporadically. In average, new rabbit farmers in Semarang and Temanggung Districts started to raise their small scale farming with 2 – 4 mature female rabbits and one buck. Obviously, rabbits are housed in the bamboo split cages and fed simple diet. It was documented that the ten largest rabbit population in Central Java were in the districts of Semarang (27, 152 head), Banjarnegara (21,831 head), Wonosobo (15,761 head), Klaten (10,975 head), Magelang (9,983 head), Temanggung (8,587 head), Banyumas (8,055 head), Pati (7,992 head), Rembang (7,890 head), and Batang, (7,559 head). Moreover, rabbit population in Central Java from the year 2001 to 2005 increased 9.8% (125,649 to 182,479 head). In conclusion, it was indicated that village rabbit farming in Central Java are well developing.

Key words: rabbit, population, development, perspective, village, Central Java.

A CASE STUDY ON THE MARKETING OF THE VILLAGE RABBIT INDUSTRY IN SEMARANG DISTRICT

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It is well understood that marketing is one of the most important factors for successful rabbit industry. Indeed, marketing information is also a very important factor for strategic planning in rabbit industry development. Previous document showed that the largest rabbit population in Central Java was in Semarang District. However, there has been no information available in marketing of small rabbit industry in the villages of this district. The purpose of the current case-study was to determine the system, pattern, and sequence of rabbits marketing in the villages of Semarang District. Data of such information were obtained through a rapid rural appraisal method. Results indicated that small rabbit farmings in the villages started in the early 2005. It was found that there were 15 – 20 farmers in each village raised small scale rabbit farming. Rabbits were raised in the small scale operation under simple traditional management. Farmers showed that system of marketing was cash payment in two ways of marketing pattern and sequence. First, the beginner farmers purchased some stock to start a small scale rabbit raising from their neighbour who has already established their rabbitry, or from the local livestock market. Second, the broker or middlemen visited the rabbit farmers, bought some growing rabbits (about 2 months old or older) available in the village, and sold the rabbits at the local livestock market or to the meat processor. It is suggested, to get higher income, farmers sell their products directly to the meat processors, such meat ball seller and/or noodle seller.

Key words: rabbit, small scale industry, village, marketing, system, pattern, sequence.

CHEMICAL COMPONENTS OF MEAT FROM RABBIT FED INCREASING DIETARY LEVELS OF LYSINE

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This research was aimed to evaluate the effect of increasing levels of lysine in rabbit diet on the nutrient content of meat. Chemical components evaluated were concentration of cholesterol, fat, calcium, and protein. Twenty five female rabbits with initial body weight of 1513 ± 99.4 gram were used in a Completely Randomized Designed (CRD) and were fed pelleted diet containing 18% crude protein and 2400 Kcal/kg DE. Inclusions of synthetic L-lysine-HCl were 0.60, 0.66, 0.72, 0.78, and 0.84%. Data were analyzed using Analysis of Variance followed by Duncan Multiple Range Test (DMRT). Results showed that consumption of feed, dietary protein and calcium, and content of fat

and protein from meat were not affected by increasing dietary lysine level ($P>0.05$). However, meat calcium content was significantly influenced by dietary lysine level ($P\leq 0.05$). Meat calcium of rabbit fed dietary lysine of 0.72-0.84% was higher than those of rabbits fed 0.60-0.66% lysine-containing diet. Increasing dietary lysine up to 0.84% resulting dietary amino acid imbalance but it did not influence the meat chemical components, except calcium deposition increased almost 20%, when lysine was added to the diet more than 0.72%.

Key words: Rabbit, Lysine, Meat, Cholesterol, and Calcium.

PRESENT STATUS OF RABBIT IN JAYAWIJAYA DISTRICT, PAPUA

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A study on the present status of rabbit in Jayawijaya was conducted in 2005 using survey method. Data were gathered from Livestock Service and key informan. Results showed that compared with other districts in Papua Province, Jayawijaya had the highest population of rabbits, about 17.000 heads. Rabbits were introduced by missionaries at Jayawijaya in early 1960 to improve nutrition of the local people. In term for social status, rabbit is inferior to the pigs, because at any cultural festivities pigs is required for consumption or for forgiveness from punishment of people who are ignorant to the culture. Most of the local people consume only pork at their ritual parties or festival culture. However, meat of rabbit is a potential protein sources to meet their protein consumption need. Rabbits were raised by local farmer as a side work to their daily household activities. Most of meat produced were consumed by the family and some were sold to get cash income. Most of rabbit farmers had rabbit pen. Rabbits roamed during dtime and werere kept in the pen at night. Feed supplement was hardly provided to the rabbits. Based on information gathered, it could be concluded that rabbits may play an important role to improve the people diet only if their productivities can be improved.

Key words: present status, rabbit, productivity.

THE PRODUCTION AND REPRODUCTION PROFILE OF RABBIT AT BUMIAJI DISTRICT, BATU CITY, EAST JAVA.

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Aim of this study was to find out the production and reproduction profile of rabbit raised at a Cooperative of rabbit breeders 'AKUR', Bumiaji District of Batu City, East Java. This study was carried out from August to October, 2006. Data were collected from 10% of breeder members that were selected by purposive sampling. Three breeds of rabbits, i.e. New Zealand White, Rex and Flemish Giant were the most common breed raised by farmers. The variables observed included reproductive traits such as early mating, service per

conception, length of gestation and calving interval, litter size at birth and weaning, number of born alive, age and weight at weaning, and weight of adult rabbits. New Zealand White, Rex and Flemish Giant rabbits had litter size of 7.67, 7.60 and 7.17 kits respectively; number of live kits at birth were 7.30, 7.31 and 6.92 heads; number of kits at weaning were 7.06, 7.13 and 6.66 heads; age of weaning were 21, 5.36 and 5.37 weeks; weight of weaning were 475.61, 545.67 and 508 g; while weight of adult rabbit were 2721, 2771 and 2384 g, respectively. Other measured reproductive traits of does, such as age at the first mating was 21.23, 20.97 and 20.95 weeks; service per conception was 1.10, 1.10 and 1.15; length of gestation was 30.80, 30.62 and 30.48 d; while calving interval was 41.11, 41.84 and 43.07 d, respectively. Litter size, number of kits at birth and number of kits at weaning were high, while kits mortality was less than 4%. However, weaning age, weaning weight and adult weight were lower than those of rabbits raised in the sub tropic regions. Service per conception was very good where less than 1.2. It is suggested the breeder farmers that breed selection and feed management must be carefully noticed for better production and reproduction performance.

Key words: rabbit, kits, production, reproduction.

PROBIOTIC POTENTIAL OF LACTOBACILLUS ACIDOPHILUS AND MICROFLORA OF KEFIR AS IMMUNOSTIMULANT.

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Probiotic is a food supplement that contains live microorganisms, which gives beneficial effect in health to their host by improving the equilibrium of intestinal microflora. The most common microorganisms that is used as probiotic are bacteria, yeast and mold. *Lactobacillus acidophilus* and microflora of kefir are the example of lactic acid bacteria and yeast that can have role as probiotic. This research was conducted at Dairy Production Laboratory; Animal Breeding and Genetic Laboratory; and Small Ruminant Laboratory in Department of Animal Production, Faculty of Animal Science, Bogor Agricultural University from April until August 2001. The aim of this research is to study the role of probiotic (*Lactobacillus acidophilus* and microflora of kefir) on immune system activity in rabbit's blood. Parameters used in this research were total leukocyte, leukocyte differential, phagocytic index and the existence of antibody. The present of probiotic is expected to improve number and activity of immune cell in blood. This research used 24 male rabbit (2-3 months old) with body weight around 1000-1500g, *Lactobacillus acidophilus* and kefir starter, dilution index, culture media, *Staphylococcus aureus*, Turk's solution, Giemsa color media, methanol, buffer phosphate (PBS) and EDTA (natrium-ethylene-diamine tetra acetic acid). *Lactobacillus acidophilus* and kefir starter were given to the animal orally. A complete random analysis factorial design $2 \times 4 \times 4$ was

used in this research with type, concentration and time duration for giving probiotic to rabbit as treatment factors. Each treatment was repeated three times. Data is analyzed using analysis of variance and significant difference was analyzed by Duncan Multiple Range Test. The significant role of *Lactobacillus acidophilus* and microflora of kefir as immunostimulant was demonstrated. Rabbits, which were treated by kefir, had higher average improvement of total leukocyte, lymphocyte, neutrophile, phagocyte index and the value of antibody titer than those of rabbits treated by *Lactobacillus acidophilus*. Results indicated that kefir as a mixture culture had better immunostimulant effect than *Lactobacillus acidophilus*.

Key words: *Lactobacillus acidophilus*, probiotic, microflora, immunostimulant.

THE POTENTIAL OF *LACTOBACILLUS ACIDOPHILUS* AND MICROFLORA KEFIR PROBIOTICS AS ANTIHYPERCHOLESTEROLEMIC AGENTS

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Probiotics have been well known for its benefits in health. Probiotics will promote the growth of friendly bacteria such as lactic acid bacteria in the intestine so that it will inhibit the development of pathogenic bacteria and reduce the blood cholesterol level. High blood cholesterol level can cause hypercholesterolemic and may lead to atherosclerotic and coronary heart disease (CHD). This research was conducted at Dairy Production Laboratory; Small Ruminant Laboratory in Department of Animal Production, Faculty of Animal Science; and Biochemistry Laboratory in Department of Chemistry, Faculty of Mathematics and Sciences, Bogor Agricultural University from May until August 2001. The purpose of this research was to determine the effect of feeding *Lactobacillus acidophilus* and microflora kefir as probiotics in rabbit blood on total cholesterol, HDL, LDL and triglyceride levels. Male New Zealand White rabbits (2-3 months old) at about 1000-1500 g were housed in steel cages throughout the study. Before feeding process with probiotics, rabbits were fed diet containing 0.5% crystallin cholesterol and the result was analyzed by t-student test. *Lactobacillus acidophilus* and microflora kefir were used as probiotics. The rabbits were fed orally with different levels of probiotics (0%, 0.1%, 0.2%, 0.3%) based on rabbit's weight. A complete randomized design with seven treatments and three replications for each treatment was used in this research. Data were analyzed by t-students test and variance procedures. A feeding process with crystalline cholesterol in a preliminary research increased total cholesterol, HDL, LDL, and decreased triglyceride levels. *Lactobacillus acidophilus* and microflora kefir was failed to show a significant difference in the above parameters, hence it could not be assumed as antihypercholesterolemic agents. At the end of the experiment, the cholesterol value in meat was examined. It was found that the value of cholesterol in rabbit's meat were very low.

Key words: *Lactobacillus acidophilus*, probiotic, microflora, antihypercholesterolemic

ISOLATION, BIOCHEMICAL AND ANTIBIOTIC SENSITIVITY TESTS OF *MYCOPLASMA* SP ISOLATED FROM RABBIT

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The literature search showed that no *Mycoplasma* infection of rabbit has been reported in Indonesia. Most of the respiratory infection in rabbits is due to bacterial infections other than *Mycoplasma*. In February 2006 there were 10 New Zealand White rabbits sent to the Centre for Research Institute for Veterinary Science in Bogor for a routine examination. On necropsy, one of those rabbits showed inflammation of the lungs and two types of small and large colonies of glucose fermenting *Mycoplasma* sp were isolated from the lungs. These isolates were then cloned and purified 6 times before further examination. Each isolate of small and large colonies of the *Mycoplasma* sp. was tested against biochemical and antibiotic sensitivity tests against several antibiotics to determine the characterization of the organisms and its sensitivity. The results of the tests are discussed.

Key words: rabbit, *mycoplasma* sp, antibiotic sensitivity, biochemical test.

ENTERIC DISEASES AND OTHER RELATED PROBLEMS IN RABBITS

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Rabbits are not only raised for pet animals but also for commercial purposes such as for meat and fur. Nowad, there are many farmers in Indonesia raising commercial rabbits not only for additional income but more than that, it is a business oriented activity. Rabbits are profitable animals and have average life span about 7 to 10 years of age. These animals are monogastric, possess a unique and delicate digestive system. The most common problems encountered in rabbit health is enteric diseases and other related problems corresponding with digestive system. The causative agents of the problems could be due to infectious agents such as bacterial or parasite infections or non infectious agents. Clinical symptoms of the disease varied, ranging from anorexia, poor weight gain, bloat, fever, watery diarrhea to hemorrhagic enteritis. The diagnosis of the disease and the treatment of its problem are reviewed.

Key words: rabbit, enteric, digestive system.

COMPARISON OF LIVER COCCIDIOSIS THERAPY IN RABBIT (*ORYZOLAGUS CUNICULUS*) USING TOLTRASURIL AND CYGRO IN DRINKING WATER AND FEED OR IN THE FORM OF CAPSUL

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There were 6 groups of 15 New Zealand White (NZW) rabbits age of 6 weeks that were free from coccidian. Group I received 5 ppm of cygro coccidiant that was mixed in their diet while group II received 5 mg per kg body weight of cygro within gelatin capsules, which were given per os every 5 d. Group III were given, 25 ppm of toltrazuril coccidiostat in the drinking water, while 20 mg per kg body weight packed within gelatin capsules were given per os to group IV which were being inoculated per os every 5 d. These coccidiostats were given continuously until the end of the experiment, while challenge was applied three d after the coccidiostat treatment. Group V was used as a control group with challenge, while group VI as a control group without challenge. The results of the experiment indicated that coccidiostats which were packed in the gelatin capsules, then given per os to rabbits were more effective than if they were mixed directly with feed or drinking water, because after they were challenged the mortality rate was smaller or zero, the growth average by body weight was normal. Oocyst production was very small and the lesion score of the liver only showed the presence of coccidiasis.

Key words: rabbit, toltrazuril, cygro, *Eimeria stiedae*.

GASTROINTESTINAL DISTURBANCES IN RABBITS

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The most disturbing conditions on rabbits is gastrointestinal problem. The conditions commonly produce constipation. Effect of slowdown activities of intestinal motility causes gas accumulation. Further processes, partly due to digestion process, caused gas accumulation in stomach, intestines and caecum to occur, an make abdomen distended (bloat). Gas pressure produces pain on the abdomen (colic). This incidence causes high acute mortality rate. Frequency of occurrence on baby rabbits is high especially at weaning time (age 4-7 weeks). Cosequently high economic loss occurred, either due to mortality or low body weight gain.

Key words: rabbits, digestion, bloat, colic.

FINDING OUT PARASITIC AND MYCOLOGIC DISEASES IN RABBIT AND THEIR CONTROLS

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The productivity of rabbits is significantly influenced by their health. The diseases that attack rabbits should be understood by rabbit keepers. Diseases can be caused by various organisms. The organisms that have important roles in rabbit health are parasitic an mycotic organisms. Although both of these microorganisms seldom cause death, the economic loss is considerably high in the form of lower productivity, especially in meat and fur production. In this paper, it is described some parasitic and micotic diseases and the attempt to control the disease caused by fleas, flies, lice, mites, ticks, worms, protozoa and fungi. Generally, the prevention is done through sanitation and nutritious feed. Treatment can be done by anthelmintics, acaricide, fungicide, and anti inflammatory agents.

Key words: parasitic, mycotic, disease, rabbit.

RABBIT AS A GERM PLASM TRANSPORTER: INTRAUTERINE TRANSPLANTATION OF EWE OVARIAN TO PSEUDO-PREGNANCY RABBIT

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This research aimed to analyze the ewe ovarian status post intrauterine transplantation to pseudo-pregnancy rabbit. The ewe ovarian was transplanted to each cornua uteri of rabbit in d 1 of pseudo-pregnancy and in d 5 or 7 after transplantation the ewe ovaries was recollected. Description of completed ovaries post-transplantation were scored with 4 (90 – 100% completed), 3 (70 – 90% completed), 2 (50 – 70% completed), and 1 (<50% completed). The numbers of follicles were counted by paraffin wax method and HE stained. The data of ovarian status scores were transformed into a log value and then were tested by t-Student analysis. Data of numbers of follicles were analyzed by ANOVA and DNMRT. Results showed that transplanted ewe ovarian still alive until 5 or 7 d after transplantation. In d 5 and 7 post-transplantation, the ovaries showed similar status. The numbers of follicles were not significantly higher ($P < 0.05$) between control (11,808) compared to 5 d post-transplantation group (10,178). The numbers of follicles in d 7 post-transplantation group (7,947) decreased significantly ($P < 0.05$) compared to the control and 5 d post-transplantation group. It can be concluded that intrauterine transplantation of ewe ovarian to pseudo pregnancy rabbit could be used as a mean of preserving the ovaries.

Key words: intrauterine transplantation, ovaries, follicles, pseudo pregnancy.

