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(a study on nutritive value of rabbit meat)

โดย

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NUTRITIVE VALUES OF RABBIT MEAT : NEW ZEALAND WHITE, THAI NATIVE AND CROSSBREDS

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Abstract

Twelve carcasses were randomly selected from New Zealand White (NZW), Thai Native (N) and two reciprocal crosses between NZW and N rabbits, three from each breed group. Proximate analysis was made along with fatty acid and amino acid analysis. Percent fat and ash on dry matter basis were the only two proximate analysis found to be different among 4 breed groups ($P < 0.05$) and N meat had more fat than N x NZW group ($P < 0.05$). Among the 18 amino acids analysed, NZW and NZW x N meat had more proline than N x NZW group ($P < 0.05$) and N x NZW meat contained more tryptophan than N and NZW ($P < 0.05$). From the eight fatty acids analysed, α -linolenic acid content in NZW meat was greater than the other 3 breed groups ($P < 0.05$).

Key Words : Rabbit meat, Nutritive value.

Introduction

Rabbit production for meat purposes has been increasing because rabbit requires short time and less space to grow. Rabbit meat is high in protein and low in fat contents. It has a low content of saturated fatty acids, cholesterol and sodium. It is suitable for heart disease patient (Cheeke, 1982).

Rabbits in production nowaday belongs to genus Oryctolagus (Cheeke, 1982 and Pravot, 1988). There were 39 breeds and 90 varieties recorded by American Rabbit Breeding Association. For Thai people, New Zealand White

rabbit are familiar for their wide use as laboratory animals. It was brought in from overseas (Somsakdi, 1985) and raised as pet and for laboratory use. Native rabbits were captured from forest, mainly as food, and were raised in backyards for meat purposes. Some other breeds as Californean, Flemish Giant and Dutch are also imported but of lesser extent. Since rabbit production is gearing towards meat for consumption, it is interested to know the nutritional properties of rabbit meat and breeds which contributed to a superior meat quality.

Material and Method

Meat from four breed groups of rabbits, 3 samples per breed, were randomed from previous study of Suwanna and collegues on Carcass evaluation. The four breeds were purebred New Zealand White (NZW), Thai Native (N) and their reciprocal crosses (N x NZW and NZW x N). Pork, beef and broiler meat were purchased from a local market in Bangkok.

Samples were blended in wearing blender at low to medium speed. Moisture in fresh samples were determined. Blended samples were dried in drying oven at 60 C for 18 - 20 hrs and kept in air tight container for further analysis.

Proximate analysis were determined using standard methods in AOAC 1975, samples were analysed for moisture, crude protein, crude fat and ash contents. Results were reported as percent fresh meat and percent dry matter.

Amino acid analysis. Except for tryptophan , 17 amino acids were analysed by Amino acid analyzer Liquinat III (Kontron). Samples were prepared for analysis by acid hydrolysis of protein. For tryptophan determination, samples were alkaline hydrolysis by Barium hydroxide and tryptophan contents were assayed colorimetrically with dimethyl aminobenzaldehyde using Varain super sgan III. Amino acids were reported as mg/g dry sample weight.

Fatty acid analysis. Using British Standard Methods of analysis BS 684 : Section 2.34 and Section 2.35 : 1980. Samples were prepared for methyl esters of fatty

acids and analysed by gas-liquid chromatography. Fatty acids were reported as percent of total fatty acids.

Data were analysed using analysis of variance and Duncan's New multiple range test.

Results and discussion

Proximate analysis results were shown in Table 1. When fresh samples were analysed, meat compositions of the four breed groups showed no statistical difference. On dry matter basis, fat and ash content differed. N breed showed greater ($P < 0.05$) fat content (20.11 $\pm$ 0.50) than N x NZW group (17.90 $\pm$ 0.71). Ash content of NZW (5.21 $\pm$ 0.48) was higher ($P < 0.05$) than N (4.61 $\pm$ 0.01), N x NZW (4.57 $\pm$ 0.28) and NZW x N (4.50 $\pm$ 0.16). As protein content were not differed, fat content in meat was singly considered in selection of breeds for better meat source .

The fact that human health was affected by foods they eat arouse the awareness in dietary compositions. Fat was always part of meat, and serum cholesterol was affected by type of fat in diet (Shi-Yen,1989). When type of fat was unknown, leaner meat was preferred. In this study,N x NZW meat was selected for it's low fat content.

Table 2 demonstrated chemical compositions of rabbit meat surveyed from former investigators. Values shown were obtained from meat of different origin. They were differed in genus, breed and age at slaughter. Rabbit meat from Lepus cuniculus (FAO, 1972) showed superior quality. It was highest in protein (22.2%) and lowest in fat (4%) levels. Second to this was meat from the four breed groups in present study. Nowaday, Lepus cuniculus are replaced by Oryctolagus cuniculus. NZW and N or their crosses should be considered breeds of choice. Since carcass compositions were influenced by age at slaughter (Rao, 1978), NZW at 18 weeks of age would yield superior meat composition.

Amino acid analysis results were shown in Table 3. The overall view of amino acid contents showed that N breed had least values except for glycine and proline.

Crossbreds showed higher amino acid content and NZW x N were highest almost in all items of amino acid. However, significant differences were found only in tryptophan and proline. Tryptophan in N x NZW (12.98 ± 0.29) was higher ($P < 0.05$) than NZW (10.97 ± 0.18) and N (10.76 ± 0.11). In contrast, proline in N x NZW (21.56 ± 2.63) was lower ($P < 0.05$) than NZW (31.90 ± 7.81) and NZW x N (31.46 ± 0.71). Phenylalanine in N (25.79 ± 1.21) tended to be lower ($P < 0.1$) than NZW x N (30.15 ± 0.95). Lysine were comparable though the two crossbred groups showed slightly higher values. Results suggested from amino acid content view that crossbred meat were superior to purebreds NZW and N.

When amino acids were expressed as percent of protein to reflect protein quality, N x NZW meat contained highest level of all essential amino acids and alanine, except for phenylalanine, cystine and tyrosine. NZW x N, on the contrary, contained highest level of all non-essentials, except alanine. It showed that crossbreds meat contained better quality protein when compared to other breed groups. In addition, when Lepus cuniculus meat (FAO, 1972) was included, higher values were shown with four essentials and one non-essential (leucine, lysine, Phenylalanine, tryptophan and arginine) exception. N meat contained lowest level of all essential and non-essential amino acids excluding proline. Results showed effect of breeds on protein quality. When 18 wk NZW meat in present study was compared to 8 wk NZW (Rao, 1979), all essential amino acids except phenylalanine were lower. Results reflected effects of age at slaughter. Younger rabbit meat yielded better quality of protein. However, lysine content in present study was lower than Lepus cuniculus and 8 wk NZW, but was higher than Moughan's (1988) 53 days NZW meat. This suggested further investigation in age at slaughter of the four breed groups.

When amino acids were expressed as percent of lysine, NZW x N and N breed groups showed more numbers of high values amino acid. As amino acid requirement of

adult human are linear in pattern, i.e. histidine 8 - 12, isoleucine 10, leucine 14, lysine 12, methionine + cystine 13, phenylalanine + tyrosine 14, threonine 7, tryptophan 3.5, and valine 10 mg/kg/day (Olson, 1984), meat from these two breed groups should be considered proper for human consumption for their provision of similar amino acid pattern.

Fatty acid analysis results were shown in Table 4. Total unsaturated fatty acids (U) were higher than total saturated fatty acids (S) in all four breed groups, having NZW as the highest (64.30 ± 0.36). U/S ratio were 1.84, 1.72, 1.75, and 1.70 in NZW, N, N x NZW and NZW x N respectively. Polyunsaturated fatty acids (P) were also highest in NZW (25.73). P/S ratio were 0.74, 0.66, 0.65 and 0.66. However, significant differenecs were found only in α -linolenic and other fatty acid which could not be identified. α -linolenic in NZW meat (1.90 ± 0.10) was the highest ($P < 0.01$) when compared to N (1.33 ± 0.23), N x NZW (1.57 ± 0.15) and NZW x N (1.6 ± 0.10). Other fatty acids in N group (1.73 ± 0.45) were significantly higher ($P < 0.01$) than NZW x N (1.17 ± 0.58) and NZW (0.80 ± 0.10) which also differed to N x NZW (1.53 ± 0.20).

As stated in previous section on fat content of rabbit meat, types of fat and the relative proportion of S to U or P could influence blood lipid level, degree of artherosclerosis and its complications. S increased blood cholesterol while U, especially P of n-6 and n-3 families lowered the degree of artherosclerosis and cardiovascular disease by decreasing blood cholesterol and triglycerides (Supis, 1980, Prasan, 1986). In addition, P were essential fatty acids. Both linoleic and α -linolenic were required for synthesis of prostaglandins and cell structures. α -linolenic, on the other hand, gave sparing effect for normal nerve function (Prasarn, 1986). In relation to the above informations, NZW meat was considered a good meat source for human.

When values from 18 wk NZW meat in present study was compared to 8 wk NZW meat of Rao's (1979) fatty acid

contents in older rabbit showed lesser S, P and α -linolenic acid but greater U . Since younger rabbit meat provided higher level of α -linolenic acid, age at slaughter of rabbit in present study should be diminished from 18 wk.

Table 5, 6, 7 demonstrated values on proximate analysis, amino acid analysis and fatty acid compositions of rabbit meat, pork, beef and chicken meat (broiler). Broiler meat had highest water content (77.03%) but lowest protein (18.15%). Beef was highest in protein (21.23%) and ash (1.26%). Pork was highest in fat (7.50%) while rabbit meat was lowest (5.00%). Beef and rabbit meat were comparable for their higher protein and lower fat contents. On dry matter basis, it was shown that broiler meat was highest in protein when pork was highest in fat. Beef was lowest in protein and fat. Rabbit meat was second highest and second lowest in protein and fat. If protein and fat were used to judge the properties of meat, rabbit meat was shown optimized. However both characters may be clarified by their amino acids and fatty acids profile.

Amino acid contents of broiler meat showed highest values except for lysine, cystine and glycine. Lysine was the third (56.18 mg/gm) from the highest (60.54) in rabbit meat. In percent of protein, beef showed highest content of all amino acids excluding histidine and proline, which reflected the highest protein quality. In relation to lysine, broiler meat had highest level of amino acids except for, histidine, tryptophan , cystine, tyrosine and glycine which were highest in pork.

For fatty acid compositions, beef showed highest S when rabbit meat contained lowest. On the contrary, rabbit meat and pork were riched in U (62.84 and 60.9), broiler were the third riched (51.0) and beef were poorest (38.1). Rabbit meat was also highest in P (24.27), linole ic (22.67 $\pm$1.34) andα - linolenic (1.60 $\pm$ 0.25). Results showed that rabbit meat was highest in quality, pork was the second, and broiler meat and beef were the last two.

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Conclusion

Among the four breed groups under investigation, nutritive values of rabbit meat showed uniformity in protein content and quality. NZW meat had superior quality because of their fatty acid profile. For the same reason, rabbit meat was superior to pork, beef and broiler meat. However broiler meat was superior for protein and amino acid contents, but beef contained higher quality of protein.

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Table 1. Proximate analysis of rabbit meat, percent.

Nutrients	Sources of rabbit meat			
	NZW	N x NZW	NZW x N	N
percent of fresh meat				
Moisture	74.33±0.67	72.78±1.00	73.57±1.41	74.79±0.35
Crude protein	20.58±0.26	20.25±0.14	20.41±0.39	20.52±0.36
Fat	4.93±0.13	4.87±0.21	5.12±0.06	5.07±0.15
Ash	1.34±0.13	1.24±0.07	1.19±0.07	1.16±0.02
percent of dry matter				
Crude protein	80.22±3.12	74.43±2.32	77.40±5.60	81.41±2.48
Fat	19.22±0.86^{ab}	17.90±0.71^{b}	19.41±1.80^{ab}	20.11±0.56^{a}
Ash	5.21±0.48^{a}	4.57±0.28^{b}	4.50±0.16^{b}	4.61±0.01^{b}

Values with different superscripts in the same row are significantly different ($P < 0.05$).

Table 2. Chemical composition of rabbit meat of different status and origin, percent.

Origin	Status	Chemical composition, percent			
		moisture	crude protine	fat	ash
FAO, 1972	Lepus cuniculus	72.5	22.2	4.0	1.3
	Lepus culus	74.5	16.9	7.4	1.0
Rao, 1978	NZW 8 wk	71.4±0.73	18.9±0.34	8.2±0.92	-
	12 wk	71.1±0.45	18.8±0.60	9.6±1.12	-
	16 wk	69.0±1.20	19.1±0.69	9.9±0.93	-
Rao, 1979	NZW 8 wk	71.0±0.39	18.5±0.22	7.4±0.28	-
Lukefahr 1982	NZW 8 wk	69.7	17.18	11.15	0.91
	FG* 8 wk	72.7	17.66	8.05	1.01
	FGxNZW 8 wk	69.9	17.67	0.87	1.01
MAFF/ADAS,1987	n.a. young	-	20.7	3.8	1.5
	adult	-	20.9	6.2	1.3

* F.G = Flemish Giant

Table 3. Amino acid composition of rabbit meat mg/g dry sample.

Aamino acids	Sources of Meat			
	NZW	N x NZW	NZW x N	N
Histidine	17.14±3.00	18.44±0.41	18.50±0.29	18.14±0.38
Isoleucine	27.75±4.17	29.56±0.81	29.72±0.49	26.37±0.98
Leucine	52.92±8.27	53.55±3.68	54.59±1.67	49.86±1.94
Lysine	60.75±9.84	62.88±2.84	62.65±4.16	55.87±2.38
Methionine	18.32±3.72	19.68±0.81	19.26±0.65	16.94±3.00
Cystine	8.34±1.38	8.17±0.28	8.69±0.80	8.18±1.38
Phenylalanine	27.24±3.49	28.80±0.87	30.15±0.95	25.79±1.21
Tyrosine	23.15±3.08	22.97±1.09	23.98±0.64	20.92±0.53
Threonine	30.51±4.64	30.37±1.37	31.29±1.25	27.87±1.43
Tryptophane	10.79±1.80[b]	12.98±0.29[a]	11.95±0.20[ab]	10.76±0.11[b]
Valine	30.68±3.94	32.12±1.47	33.22±0.35	29.87±1.01
Alanine	38.75±4.86	38.58±1.32	39.97±1.32	35.96±2.16
Arginine	41.50±5.92	45.21±7.44	48.77±2.44	41.25±1.09
Aspartic acid	60.85±9.10	61.83±2.87	64.67±1.10	57.34±2.54
Glutamine	111.05±16.89	109.11±8.94	114.70±3.75	100.29±5.19
Glycine	34.22±3.15	31.97±0.71	35.04±3.44	32.54±3.28
Proline	31.90±7.81[a]	21.56±2.63[b]	31.46±0.71[a]	28.53±2.78[ab]
Serine	26.90±3.91	26.80±0.91	28.23±0.39	24.85±1.45

Values with different superscripts in the same row are significantly different ($P < 0.05$).

Table 4. Fatty acid composition, percent of total fatty acid.

Fatty acid		Sources of Meat			
		NZW	N x NZW	NZW x N	N
Saturated, total		34.90±0.46	35.77±0.76	36.63±0.38	36.13±1.90
Lauric	12:0	0.3±0.00	0.43±0.11	0.33±0.05	0.37±0.15
Myristic	14:0	2.3±0.23	2.47±0.35	2.13±0.21	2.23±0.21
Palmitic	16:0	25.8±0.17	26.40±0.72	26.97±0.21	26.47±1.16
Stearic	18:0	6.47±0.15	6.47±0.59	7.20±0.72	7.03±0.81
Unsaturated, total		64.30±0.36	62.70±0.65	62.20±0.43	62.17±2.35
Palmitoleic	16:1,n-7	3.97±1.22	3.73±0.61	2.80±0.53	2.53±0.32
Oleic	18:1,n-9	34.60±0.87	35.83±0.55	35.11±0.87	35.73±1.30
Linoleic	18:2,n-6	23.83±1.78	21.57±0.55	22.70±1.08	22.57±1.17
∝-Linolenic	18:3,n-3	1.90±0.10^{a}	1.57±0.15^{b}	1.60±0.10^{b}	1.33±0.23^{b}
Others		0.80±0.10^{c}	1.53±0.21^{ab}	1.17±0.58^{bc}	1.73±0.45^{a}
Polyunsaturated		25.73	23.14	24.30	23.90
U/S		1.84	1.75	1.70	1.72
P/S		0.74	0.65	0.66	0.66

Values with different superscripts in the same row are significantly different (P < 0.05)

Table 5. Proximate analysis of rabbit meat, pork, beef and broiler meat.

Nutrients	source of meat			
	rabbit	pork	beef	broiler
Percent of fresh meat				
Moisture	73.87±1.13	72.44	66.96	77.03
Crude protein	20.44±0.29	18.81	21.23	18.15
Fat	5.00±0.16	7.50	5.54	5.48
Ash	1.23±0.10	1.16	1.26	1.22
Percent of dry matter				
Crude protein	78.37±4.19	68.25	64.25	79.01
Fat	19.16±1.09	27.21	16.76	23.85
Ash	4.72±0.39	4.20	3.81	5.31

Table 6. Amino acid composition of rabbit meat, pork, beef and broiler meat, mg/g dry sample

Amino acid	sources of meat			
	rabbit	pork	beef	broiler
Histidine	17.56±1.66	24.0	20.30	25.72
Isoleucine	28.35±2.36	24.46	26.63	31.12
Leucine	52.73±4.41	45.39	48.74	57.03
Lysine	60.54±5.65	46.34	60.10	56.18
Methionine	18.55±2.36	15.40	16.98	20.77
Cystine	8.34±0.91	6.89	7.84	7.16
Phenylalanine	28.00±2.39	24.15	24.97	29.94
Tyrosine	22.75±1.86	19.88	20.86	23.83
Threonine	30.01±2.59	26.61	27.06	32.57
Tryptophane	11.62±1.24	10.69	11.63	12.61
Valine	31.46±2.30	26.52	27.74	33.46
Alanine	38.31±2.85	33.66	35.31	41.32
Arginine	44.18±5.30	38.26	42.62	47.84
Aspartic acid	61.17±5.05	52.18	55.52	65.18
Glutamine	109.79±9.94	93.01	96.96	118.24
Glycine	33.44±2.77	27.14	28.11	31.73
Proline	28.36±5.70	27.62	26.38	39.84
Serine	26.69±2.22	22.96	24.00	27.93

Table 7. Fatty acid composition of rabbit meat, pork, beef and broiler meat, percent of total fatty acid.

Fatty acids		Sources of meat			
		rabbit	pork	beef	broiler
Saturated, total		35.85±1.12	37.60	58.30	47.20
Lauric	12:0	0.36±0.10	0.10	0.10	0.10
Myristic	14:0	2.29±0.25	1.30	1.70	2.30
Palmitic	16:0	26.41±0.73	24.20	41.90	26.30
Stearic	18:0	6.79±0.63	12.00	14.60	18.50
Unsaturated, total		62.84±1.49	60.90	38.10	51.00
Palmitoleic	16:1,n-7	3.26±0.09	2.80	4.80	2.90
Oleic	18:1,n-9	35.32±0.96	48.50	32.60	44.40
Linoleic	18:2,n-6	22.67±1.34	9.40	0.70	3.10
∝-linolenic	18:3,n-3	1.60±0.25	0.20	0	0.60
Others		1.31±0.43	1.50	3.60	1.80
Polyunsaturated		24.27	9.60	0.70	3.70
D/S		1.75	1.62	0.65	1.08
P/S		0.68	0.26	0.01	0.08