THE DETERMINATION OF APPARENTIAL METABOLIZABLE ENERGY (AME) OF SOME SOYBEAN AND MAIZE VARIETIES FOR POULTRY BY DIRECT METHODS

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Summary

The Determination of Apparent Metabolizable Energy (AME) of Some Soybean and Maize Varieties for Poultry by Direct Methods

Metabolizable energy (ME) is a measure of the energy available to poultry from their diet. ME can be expressed at their apparent (AME). AME has been the traditional measure of ME in studies of birds.

The apparent metabolizable energy (AME) values of feed ingredients for poultry in Vietnam are estimated by Nehring methods (indirect method). This method is not correct. Is necessary determined the AME by direct method.

Samples of 11 Soybean varieties: AK03, B10, Cuc Luc Ngan, D912, DH4, DT12, DT84, DT93, Lam Vang, TH4, V74 and 12 maize varieties: Bioseed 9681, Bioseed 9723, Bioseed 9797, Bioseed 989, DK – 888, LCH9, LVN4, LVN10, Pacific11, Pacific 60, Q2, Silidim for poultry feed were collected from Northern provinces of Vietnam were analyzed: The chemical composition, gross energy (GE) and AME. AME were determined by direct method of Farrell (1978).

The result indicated: the chemical composition of soybean and maize varied from varieties. The differences in GE and AME determined by both direct and indirect methods were inconsistent.

The crude protein content soybean variety ranged from 34.35 to 44.32 % (dry matter) correspondence to TH4 and DT93 varieties.

The AME values of 11 soybean and 11 maize varieties determined by direct method ranged from 3554 to 3892 kcal and 3371 to 3623 kcal/kg dry matter respectively and was difference the value determined by indirect methods. The AME values estimated by Nehring method (1973) of maize were 3215 – 3354 kcal/kg dry matter and lower than the AME values determined by direct method 4.14 to 8.92 per cent .

The variation in AME of 11 soybean and 11 maize varieties observed among direct and indirect methods indicated that confirmatory the AME of feed ingredients for poultry in the condition of Vietnam should be determined by direct method prior to using.

Key words: Apparent metabolizable energy (AME), direct and indirect methods, 11 maize and 11 soybean varieties

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1. INTRODUCTION

Maize and soybean are two commonly used feed ingredients in poultry diets. The Chemical composition and energy value of maize and soybean are different between varieties. To make up a diet that suits for specific types of poultry, evaluating metabolisable energy value of different kinds of feed correctly is very important.

The metabolisable energy (ME) system has been widely used over the world and in Vietnam to determine the energy content of feedstuffs, and to estimate the energy requirements with poultry. The ME value of feedstuffs is determined on chicken by the direct methods. According to results of the direct methods, the indirect methods, which are based on the chemical compositions of feedstuffs to predict ME content, was used. In developed countries such as US, Canada, France, Australia, the ME content in chicken feedstuffs was calculated by the direct methods in 50 – 60's of the last century. Vietnam, until now, still use the indirect methods with equations from the oversea literature to determine the ME value in feedstuffs. Ton That Son and Nguyen Thi Mai (2001a, 2001b) measured the ME value of some kinds of chicken feeds by the direct method. According to the authors, it exists a difference in ME value results of the direct and indirect methods. Zhirong Jiang (2004) measured ME value of poultry feedstuffs in Thailand, Malaysia, Batal and Dale (2006) also had the same conclusion.

Therefore, it is quite necessary to determine the ME value in poultry feedstuffs by the direct method in Vietnam. It will be a reliable basis to estimate ME requirements for poultry.

2. MATERIAL AND METHODS

2.1. Sample

In Vietnam, there are many maize and soybean varieties. 11 maize varieties are used: Bioseed 9723, Bioseed 9681, Bioseed 989, DK 888, LCH 9, LVN4, LVN10, Q2, Pacific 11, Pacific 60, Silidim; 11 soybean varieties: AK03, B10, Cuc Luc Ngan, D912, DH4, DT12, DT84, DT93, Lam Vang, TH4, V74, are cultivated in Northern area and some are used in feed industrial mills in Vietnam.

2.2. Methods of Sampling and chemical composition analysis were undertaken according to the methods of the Vietnam Standard (TCVN)

- Sampling methods according to TCVN 4325: 2006 (ISO 6497: 2002)
- Prepare trial samples according to TCVN 6952: 2001 (ISO 9498: 1998)
- The determination of dry matter content in samples was undertaken according to TCVN 4326: 2001 (ISO 6496: 1999)

% Dry matter = 100% - % Water

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- The determination of crude fiber content in samples was undertaken according to TCVN 4329: 1986

- The determination of ash content in samples was undertaken according to TCVN 4327: 1986; samples were burned at 500 – 550^{o}C.

- The determination of crude protein content in samples was undertaken according to TCVN 4328: 2001 (ISO 5983: 1997)

- The determination of crude lipid content in samples was undertaken according to TCVN 4321: 2001 (ISO 6492: 1999)

- Nitrogen- Free Extract

Nitrogen-Free Extract (%) = 100 – (%Water + %Crude protein + % crude lipid + % crude fiber + % total ash)

2.3. The determination of gross energy value (GE)

- Used the direct method which samples were burned in bomb calorimeter Parr 6300.

- Estimated GE content in some poultry feed ingredients according to Ewan method, 1989 (NRC, 1998) with the equation following:

GE (kcal) = 4143 + (56 x %crude lipid) + (15% x Crude protein) – (44 x % total ash)

GE: Gross energy content (kcal) in 1 kilogram of feed.

2.4. The determination of metabolisable energy of experimental feed by the biological method (also the direct method) of Farrell, 1978 (1983)

Metabolizable energy bioassay

Apparent metabolizable energy (AME) was determined by method of Farrell (1978a; 1980a, follow up Farrell (1983): In this assay adult cockerels Luong Phuong housed in single cages are trained to consume their feed allowance in one hour by gradually reducing access to feed over a period of six weeks. Birds are starved for at least 24 hours and following feeding for one hour, excreta are collected for the next 32 hours.

* Choice of birds:

- Fifty cockerels were purchased as ten week olds.

- All the chickens were kept in natural conventional condition and fed diets as developing birds.

- After five month olds, forty birds, which had body weight in range ± 10% average body weight of group, were chosen.

- Separated each bird in individual cage and fed the basal diet as following: Maize: 91%; Fishmeal: 8%; Minerals and multivitamin premix: 1%

- Until 6 month olds, experimental cockerels were practiced to consume 800 – 110 gram of diet for one hour.

- Measured the feed transit time of test ingredients. Results showed that the transit time of all feed was less than 30 hours.

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*** Experiment 1: The determination of the metabolisable energy content (ME) in maize varieties**

- All chickens were starved for 32 hours (to empty the digestive tract)
- Clean all experimental birds: combed their feathers, clean their paws.
- Fed test ingredients for an hour and recorded feed intake.
- Covered the excreta trays by nylon sheets which weights are known.
- After 32 hours, all excreta was collected, and used H_2SO_4 5% to keep the nitrogen content in faeces.
- Excreta collected was frozen and dried in 70^oC for 8 – 12 hours. Then, dried excreta was measured and ground.
- The gross energy of the feed and excreta samples was determined using a bomb calorimeter.
- ME values were calculated using the following formula:

$$ME_N = \frac{GE_{maize}.\ N - GE_f.F}{N}$$

With: ME_N: The metabolisable energy content (kcal) in 1 gram of maize

GE_{maize}: The gross energy content of 1 gram of maize

N: The maize intake (gram)

GE_f: the gross energy content of 1 gram of excreta (kcal)

F: Excreta output (g)

After each period of experiment, birds were rested for 6 days.

*** Experiment 2: The determination of ME content of soybean**

Normally the test diet replaces 30 per cent of a basal diet. The cockerels are usually kept trained to the feeding regimen.

All experimental processes were the same with experiment 1. However, with the high protein feed, it cannot be a diet by itself. Therefore, the ME value of this kind of feed have to be measured as following:

- First, all the chickens were offered basal diet. Then, the ME value of the basal diet were calculated.
- Mixed soybean and the basal diet with the ratio 30: 70 (30% soybean: 70% the basic diet) to make the experimental diet. Then, measured the ME value of the experimental diet.

Results:

$ME_{ExF} = ME_{BasalD} + [(ME_{ExF} – ME_{BasalD})/ 30] \times 100$

With:

ME_{ExF}: The ME value (kcal) of 1 gram of experimental feed.

ME_{BasalD}: The ME value (kcal) of 1 gram of the basal diet

ME_{ExF}: The ME value (kcal) of 1gram of the experimental diet

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2.5. Prediction of metabolizable energy content of some poultry feedstuffs

2.5.1. The Nehring method, 1973 (VCN, 1995)

The ME values of feed ingredients for poultry were predicted with the equation following:

ME (kcal/kg feed) = 4.26. X1 + 9.5 X2 + 4.23 X3 + 4.23 X4

X1, X2, X3, X4: Digestible protein, digestible lipid, digestible fiber, digestible nitrogen – free extract (g/kg)

The coefficient of the nutrients were used according to VCN (1978)

2.5.2. The Janssen method, 1989 (NRC, 1994)

- With the grain group:

ME (kcal/kg of feed) = 36.21 % Crude protein + 85.44% Crude lipid + 37.26 % Nitrogen- free extract

- Whole soybean:

ME (kcal/kg of feed) = 2,636 + 82.5 % Crude lipid – 55.7 %Crude fiber

3. RESULTS

3.1. Experiment 1: The Determination of Chemical Composition, the ME value of Some Maize varieties

3.1.1. The Chemical Compositions of Some Maize Varieties

Maize has the high-energy content, so it is always used to adjust the energy level of diets. The chemical composition and nutrient values of maize were affected by many different factors. However, the most important factor is maize variety, cultivated conditions, area and weather. Therefore, to compare the ME values of maize varieties which were measured by the estimate method and the biological method, it should be known the chemical composition of them.

Results of chemical composition analysis of some kinds of maize (Table 3.1) showed that the different maize varieties would have the different chemical composition. The crude protein values of maize vary between 9.64 – 10.79% (with 100% dry matter). The highest is of Silidim variety and the lowest one is of LVN10 variety. The crude lipid contents of corn are not much different between corn varieties, the maximum is of Bioseed variety (4.7%), and the minimum is of LVN 10 (2.84%). The crude fiber and total ash content of corn range from 2.39 – 4.02% (with crude fiber), and from 1.34 – 3.60% (with total ash). The nitrogen-free extract content of corn is in 67.07 – 79.40% range.

The analysis result also showed that the variation of water content of maize between 10.90 – 13.31 %, in the standard range (<14%). The highest one was of Silidim variety, and the lowest one was of Bioseed 9723 (10.90%). The water content or the moisture of corn is one of the important factors, which not

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only affects the quality of corn, but also storage time. The high moisture causes corn to be infected by mould or weevils in storage process.

Table 3.1. The Chemical Composition of Some Maize Varieties

Maize Varieties	Moisture (%)	Crude protein	Crude Fat	Crude Fibre	Ash	N. free extract
		% of dry matter				
Bioseed 9723	10.90	10.20	4.70	3.03	2.67	79.40
Bioseed 9681	12.36	10.24	2.84	2.39	2.06	68.72
Bioseed 989	13.16	10.58	3.79	3.66	1.74	67.07
DK888	11.00	10.57	3.36	3.59	3.40	79.08
LCH9	12.38	10.30	3.59	2.39	1.88	68.09
LVN4	12.44	10.29	3.65	3.25	1.87	68.48
LVN10	12.33	9.64	3.64	2.82	1.42	69.87
Q2	11.60	10.27	4.58	4.02	3.60	77.53
Pacific11	12.33	10.22	3.83	3.24	1.34	69.21
Pacific60	11.16	10.46	3.91	3.17	1.76	69.35
Silidim	13.31	10.79	2.92	3.21	2.01	67.74

3.1.2. The gross energy value (GE) of some maize varieties

To measure the ME content of poultry feedstuffs by the biological method, it is necessary to calculate the GE content of them first. The GE values of some maize varieties, which were measured by the direct method - burning the samples in the bomb calorimeter, and the indirect method of Ewan, 1989 (NRC, 1998) - predicting based on chemical composition, were presented in Table 3.2.

The GE values of some corn varieties, calculated by the direct method, were from 4071 to 4400 kcal/kg (on a dry matter basis). The highest GE value was of DK888 variety and the lowest one was of Bioseed 9681. The range of GE value between the different corn varieties such as LVN 10, Silidim, Bioseed 9681, LVN4 and Bioseed 989 had the coefficient of variation (CV %) lower than 2%. The maximum coefficient of variation in the GE value was the samples of LCH9 variety (2.64%). The less the coefficient of variation was, the more stable the GE value of corn variety was, and vice versa.

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Table 3.2. The GE value of some varieties of Maize (Kcal/ kg dry matter)

Maize Varieties	n	GE Determined ($\bar{X}$± ES (A)	CV (%)	GE Estimated ($\bar{X}$± ES) (B)*	A/B (%)
Bioseed 9723	7	4379 ± 47	2.15	4442 ± 45	98.60
Bioseed 9681	7	4071 ± 33	1.81	4334 ± 17	93.93
Bioseed 989	7	4279 ± 17	1.91	4437 ± 19	96.44
DK 888	7	4400 ± 51	2.32	4340 ± 48	101.4
LCH9	7	4156 ± 49	2.64	4428 ± 30	93.83
LVN4	7	4191 ± 34	1.84	4405 ± 21	95.15
LVN10	7	4255 ± 22	1.15	4485 ± 25	94.87
Q2	7	4381 ± 49	2.24	4395 ± 46	99.71
Pacific 11	7	4284 ± 41	2.13	4441 ±11	96.46
Pacific 60	7	4360 ± 45	2.32	4411 ± 13	98.84
Silidim	7	4152 ± 29	1.58	4380 ± 15	94.79

* ME Estimated by Ewan, 1989 (NRC, 1998)

Our result in measuring the GE content of maize was also similar to the result of Hullar et al. (1999), Keith Smith (1991) and Mustard et al. (1981). These authors showed that the GE value of corn were from 4452 to 4636 kcal/kg (on a dry matter basis).

The GE values of corn, which were estimated by the indirect method of Ewan 1989 (NRC, 1998), were in the range of 4334 – 4485 kcal. Thus, the GE values of corn (according to the direct method) were different from the ones (according to the indirect method). In the most case, the former was lower than the latter. The variation between them was from 1.40% (DK888) to 6.17% (LCH9). Therefore, the difference not only in variety, but also in the method of measuring also affected the GE value of maize.

3.1.3. The metabolisable energy (ME) values of some varieties of maize.

The results of the experiments, which calculated the ME values of maize by the biological method (Farrell, 1978) and the prediction method of Nehring, 1974 (VCN 1995) were presented in Table 3.3.

The ME content of maize, which was measured by the biological method, varies from 3375 to 3895 kcal (on a dry matter basis). The maximum one was of

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Bioseed 9723 (3895 kcal), the lower ones were of DK888 (3850 kcal), Q2 (3805kcal), and the minimum one was of Silidim (3375 kcal). The results showed that the ME values of corn (on a dry matter basis) had high variation between the varieties. In fact, if ME values of corn were estimated on a dry matter in producing application, they will be varied more than that. Therefore, it is worthy of notice in poultry diets, because the ME energy of corn are always about 50 – 80% energy of diets.

Table 3.3. The Metabolisable Energy (ME) values of Some varieties of Maize (kcal/kg dry matter)

Maize Varieties	n	ME determined ($\overline{X}$± ES)(A)	CV (%)	ME estimated ($\overline{X}$± ES) (B)*	CV (%)	A/B (%)
Bioseed 9723	7	3895 ± 50	2.57	3798 ± 46	3.15	102.6
Bioseed 9681	7	3381 ± 30	1.99	3215 ± 34	2.17	105.1
Bioseed 989	5	3416 ± 60	3.92	3279 ± 14	1.85	104.2
DK888	7	3850 ± 40	2.10	3702 ± 38	2.73	104.0
LCH9	6	3578 ± 69	4.32	3309 ± 12	3.72	108.1
LVN4	7	3423 ± 67	4.42	3272 ± 15	2.51	104.6
LVN10	7	3587 ± 17	1.09	3354 ± 12	2.62	106.9
Q2	7	3805 ± 43	2.25	3732 ± 43	2.61	102.0
Pacific 11	6	3479 ± 50	3.22	3332 ± 16	3.37	104.4
Pacific 60	7	3696 ± 48	3.54	3326 ± 17	3.42	111.1
Silidim	5	3375 ± 30	2.02	3240 ± 18	2.45	104,2

* ME estimated by Nehring, 1973 (VCN, 1995)

Most of our results which determined the ME values of corn varieties by the biological method on 11 varieties of corn (in 8 of 11 varieties of corn, the ME value of them were from 3375 to 3587 kcal), were similar the results of foreign authors such as Longo et al, (2004): 3360 kcal and Liesl Breytenbach, (2005): 3391 kcal but lower than the results of other authors such as Jabbar Mustard et al. (1981): 3870 kcal, Shires et al. (1987): 3620 kcal; Baidoo et al. (1991): 3647 kcal; McDonald et al. (1995): 3872 kcal; Richard (1981): 3914 kcal; NRC (1977), (1994): 3863 and 3764 kcal, Schang et al. (1983): 3600 kcal, Valdes and Leeson (1992a): 3874 kcal. In 11 maize varieties, only 3 of them (bioseed 9723,

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Q2, Pacific60) had the ME values that were found to be higher to results of foreign authors.

The ME values of maize varieties, which were calculated by the prediction method, varied from 3215 to 3798 kcal (on a dry matter basis). The highest one was of Bioseed 9723 (3798 kcal), and the lowest one was of Bioseed 9681 (3215 kcal).

As the GE value, the ME values of corn measured by the biological methods and the prediction method were different. All the ME values, which were calculated by the biological method, were higher from 2.0 to 11.1% than the one that were predicted by the indirect method. The highest difference in ME values between two methods was of Pacific 60 (11.1%), after that was LCH9 (8.1%) and the lowest one was Q2 (2.0%). These would make the ME values of maize, which were calculated by the foreign prediction method, become varied. Therefore, in the tropical weather (hot and humid weather) of our country, using the direct method to measure the ME values of poultry feedstuffs is necessary. It will be a reliable basis to predict the poultry energy requirements and other nutrient requirements for poultry also.

3.2. The experiment 2: The determination of chemical composition and the ME values of some soybean varieties

3.2.1. Chemical composition of some soybean varieties

The results of chemical composition analysis of some kind of soybean (Table 3.4) pointed out that the crude protein content of soybean varieties were in the range 34.35 – 44.41% (on a dry matter basis). The soybean variety that had the highest crude protein content was DT12 (44.41%), and had the lowest one was TH4 (34.35%)

The lipid content of soybean was quite high and varied from 15.60 to 21.87% (on a dry matter basis). Because of the high lipid content, the energy value of soybean is also high. In soybean chemical composition analysis, the crude fiber content of soybean was quite low, from 3.54 to 7.10%; the minimum one was of TH4 and the maximum one was Cuc Luc Ngan. The total ash content of soybean samples varied from 4.63 to 12.95%, the lowest one was of V74 and the highest one was of DH4. The results in Table 3.4 also showed that the nitrogen free extract content of soybean had a wide variation, from 22.64 to 36.20%.

According to the above results, we proved that: The different soybean varieties led to their different chemical composition. Therefore, to use the soybean varieties effectively in livestock, it was necessary to analyze their chemical composition and to measure their energy.

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Table 3.4. Chemical composition of Some Soybean varieties

Soybean varieties	Moisture (%)	Crude protein	Crude Fat	Crude Fibre	Ash	N. free extract
		% of dry matter				
AK03	7.54	38.46	16.06	6.81	32.10	6.57
B10	5.56	40.08	21.87	6.05	25.33	6.67
Cúc Lục Ngạn	4.48	42.00	16.74	7.10	28.51	5.65
D912	5.62	43.41	15.60	5.12	23.51	12.36
DH4	6.38	37.42	16.21	7.01	26.41	12.95
DT12	4.94	44.41	16.22	5.89	22.63	10.85
DT84	4.95	41.27	17.62	4.96	26.31	9.84
DT93	5.12	44.32	16.44	6.43	25.26	7.55
Lâm Vang	5.42	43.03	20.73	6.15	22.86	7.23
TH4	6.00	34.35	20.77	3.54	36.21	5.13
V74	5.36	41.95	18.66	4.40	30.36	4.63

3.2.2. The gross energy (GE) value of some soybean varieties

The GE values of some soybean varieties, which were measured by the direct method (burned the samples in bomb calorimeter) and the prediction method (based on the chemical composition) of Ewan, 1989 (NRC, 1998), were the basis to calculate the ME value by the direct method (Table 3.5).

The results expressed that the GE content of soybean varieties measured by the direct methods was in the range from 5042 to 5675 kcal (on a dry matter basis). The highest GE value was of B10 and the lowest one was of DH4. Church and Pond (1998), Keith Smith (1991) found that the GE value of soybean was 5500 kcal. The results of Mustard et al. (1981) verified that the GE content of soybean was from 5072 to 5243 kcal. Thus, according to our results, some soybean varieties in Vietnam had the GE value higher.

The comparison in GE value of soybean between two different methods (the direct and indirect method), we found that the variation of them was not in one side, but in side, the higher one and the lower one.

The variation in GE value between two methods was from 0.5 to 10.2%. The most different one was of DH4 (10.2%) and the least different one was of DT93 (0.5%). According to the results, we concluded that: The different soybean varieties, the different land area and the different measuring methods would lead

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to the variation of GE values, not only in one specific side (from -8.5 to +10.2%); therefore, it would be very difficult to verify them.

Table 3.5. The Gross Energy (GE) values of some Soybean varieties (Kcal/kg dry matter)

Soybean varieties	n	GE determined ($\overline{X} \pm m_{\overline{X}}$) (A)	CV (%)	GE estimated ($\overline{X} \pm m_{\overline{X}}$) (B)*	A/B (%)
AK03	7	5577 ± 31	1.32	5330 ± 35	104.6
B10	7	5492 ± 36	1.41	5675 ± 45	96.8
Cúc Lục Ngạn	7	5644 ± 38	1.40	5462 ± 31	103.3
D912	7	5496 ± 32	1.30	5124 ± 37	107.3
DH4	7	5554 ± 36	1.62	5042 ± 39	110.2
DT12	7	5300 ± 33	1.25	5270 ± 32	100.6
DT84	7	5624 ± 37	1.17	5316 ± 39	105.8
DT93	7	5368 ± 35	1.55	5396 ± 37	99.5
Lâm Vang	7	5371 ± 41	1.90	5631 ± 49	95.4
TH4	7	5118 ± 37	1.84	5596 ± 49	91.5
V74	7	5245 ± 39	2.25	5613 ± 47	93.4

* GE estimated by Ewan, 1989 (NRC, 1998)

3.2.3. The metabolisable energy (ME) value of some soybean varieties

The results (Table 3.6) showed that the variation in ME values of soybean varieties were in the range from 3554 to 3892 kcal (on a dry matter basis).

The maximum one was of Lam Vang, the minimum one was of DH4. Therefore, the ME values of different kind of soybean were not the same. These data were found to be similar to former results of other authors.

The ME content of soybean (on a dry matter basis) from NRC (1994) was 3667 kcal. As stated by McDonald (1995), this was 3726 kcal; by Church (1998): 3872 kcal; by Keith Smith (1999) was 3722 kcal. The results of Rand et al., 1996: 3680 kcal and INRA, 1989: 3750 kcal (Rosa, 2004), but Longo et al, (2004) reported higher values: 3950 – 4068 kcal.

Consequently, the different soybean varieties led to the different ME values and the wide variation. However, the ME values of each soybean varieties the coefficient of variation was quite small (1.63 – 2.49%).

The experimental results also pointed out that the highest ME value of soybean that was estimated by the Janssen method was of TH4 (4152 kcal) and the lowest one was of AK 03 (3582 kcal). If calculating by the Nehring method,

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the highest one was still of TH4 (4121 kcal), however, the lowest one was DH4 (3567 kcal). While, the highest one, which was measured by the direct method, was of Lam Vang: 3892 kcal and the lowest one were of DH4: 3554 kcal.

Table 3.6. The Metabolisable Energy (ME) value of Soybean varieties (kcal/kg dry matter)

Soybean varieties	n	ME determined ($\overline{X}$± ES) A	CV (%)	ME estimated ($\overline{X}$± ES) B*	A/B (%)	ME estmated ($\overline{X}$± ES) C**	A/C (%)
AK03	7	3572± 33	2.27	3582 ± 37	99.7	3788 ± 36	94.3
B10	7	3716 ± 36	2.37	4103± 35	90.6	4056 ± 35	91.6
Cúc Lục Ngạn	7	3795 ± 35	2.33	3622± 31	104.8	3844 ± 33	98.7
D912	7	3605 ± 24	1.63	3638 ± 29	99.1	3613 ± 37	99.8
DH4	7	3554 ± 26	1.79	3583 ± 25	99.2	3567 ± 27	99.6
DT12	7	3628 ± 28	1.89	3646 ± 31	99.5	3674 ± 29	98.7
DT84	7	3891 ± 34	2.19	3813 ± 38	102.0	3791± 36	102.6
DT93	7	3620± 26	1.76	3634 ± 25	99.6	3784 ± 26	95.7
Lâm Vang	7	3892 ± 31	1.95	4004 ± 32	97.2	4002 ± 31	97.3
TH4	7	3795 ± 27	1.74	4152± 29	91.4	4121 ± 27	92.1
V74	7	3738 ± 38	2.49	3930± 37	95.1	4031 ± 35	92.7

* ME estimated by Jensen, 1989 (NRC, 1994)
** ME estimated by Nehring, 1973 (VCN,1995)

Comparing the ME values of soybean calculated by the different methods, we found that the results from the direct method were always lower than from the indirect method. The difference was not only in the same side, but also in both sides – higher and lower. In 11 experimental soybean varieties, only two varieties had the ME values by the direct method higher than the estimated method of Janssen as following: Cuc Luc Ngan (+4.8%) and DT 84(+2.0%). If compare with the indirect method of Nehring, only DT84 had the ME values higher 2.8%. The ME values of other varieties by the direct method were lower than the ones measured by the prediction method: with the Janssen method, the variation was from – 9.4 to – 0.3%; with the Nehring method, it was from - 8.4 to - 0.2%. The most varied in ME value of soybean between two methods was of B10 (8.4 – 9.4%), and the least one was of AK03 (-0.3%) (With the Janssen method) 3572 – 3582 kcal; and of D912 (-0.2%) (With the Nehring method) 3605 – 3613 kcal.

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4. CONCLUSION

According to the results above, we had some main conclusion as following:

- The different maize and soybean varieties would have their different chemical composition. The crude protein content of maize (9.64 – 10.79%), of soybean (34.35 – 44.41%); the crude lipid content of maize and soybean were 2.84 – 4.70% and 15.60 – 21.87% respectively; the crude fibre of maize (1.34 – 3.60%), of soybean (4.63 – 12.95%).

- The different maize and soybean varieties would have their different GE value. The GE value (on a dry matter basis) measured by the direct method of maize (4071 – 4400 kcal) and of soybean (5042 – 5675 kcal).

- The GE values of maize measured by the direct method were different from the ones by the indirect method of Ewan (1989). The difference between them was in two sides, the higher one and the lower one. The variation in the GE values by the direct method and the indirect method of maize were 1.4 – 6.2%, and of soybean were 0.5 – 10.2%.

- The different maize and soybean varieties would have their different ME values. The ME values (on a dry matter basis) by the direct method of maize and soybean were 3375 – 3895 kcal and 3554 – 3892 kcal, respectively.

- The ME content of maize and soybean measured by the direct method were different from the results calculated by the indirect method of Nehring (1973).

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