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Research Paper

Estimation of Dry Material and Crude Fiber Content of Rice Bran Using Artificial Neural Network (ANN) Based on NIRS (*Near Infrared Reflectance Spectroscopy*) Absorbance Data

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ABSTRACT*: This study aims to determine the accuracy of the determination of dry matter and crude fiber content of rice bran using Artificial Neural Networks (ANN) based on NIRS absorbance data. This study used 60 samples of rice bran from various regions representing West Sumatra. NIR spectra data were obtained using a Portable Fourier Transform Near Infrared (FT-NIR) instrument with a wavelength of 1000-2500 nm. The results of the estimation of the nutritional content of rice bran were analyzed using Artificial Neural Network (ANN) with the number of hidden nodes 3, 5, 7, and 9 and the number of iterations of 25000, 30000, 35000, 40000, and 50000. NIR absorbance data processing was carried out pre-treatment of data with normalize using Unscrambler software and data treatment using the PCA (Principal Component Analysis) method contained in the IBM SPSS Statistic 21. The best prediction results can be seen in the lowest SEC, SEP and CV values. The results showed that the use of ANN with a model that has been built can predict the dry matter content and crude fiber of rice bran well and close to the actual value. The results of the estimation of dry matter have low SEC, SEP and CV values, namely SEC values of 1.02%, SEP values of 2.16% and CV of 2.36% while the results of estimation of crude fiber have SEC values of 4.04%, SEP values of 1, 43% and CV value of 5.98%.*
KEYWORDS: *Rice Bran**,** NIRS, PCA, ANN*

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I. INTRODUCTION

Feed material is one of the factors that influence the success of a livestock business in addition to paying attention to seeds and livestock raising management. One of the feed ingredients that are often used by breeders for feed ingredients is rice bran. Rice bran is a by-product or waste from rice mills that still contains nutrients needed by livestock, does not interfere with livestock health, and is easy to obtain, so that it can use rice bran as a feed ingredient properly and does not compete with human needs.

Some important things that need to be considered in preparing livestock rations are the nutritional content of feed ingredients and the nutritional needs of livestock. This is because providing the nutritional content of rations that are not suitable for livestock needs can be detrimental to farmers. Less or less of a nutrient from livestock needs can reduce the performance of livestock and / or be uneconomical. So it is necessary to optimize the preparation of ration formulations in meeting the needs of livestock.

In general, the nutritional content of a feed ingredient can be determined using conventional methods. However, the method requires a long time, a complicated procedure, and the cost of chemicals is expensive. One of the conventional methods that is often used is proximate analysis. According to [2], proximate analysis is an analysis aimed at determining the nutritional content of feed ingredients based on their chemical properties, including moisture, ash, crude protein, crude fat, crude fiber, and extracts without nitrogen.

Recently, a number of instrumentation techniques based on the physical properties of materials have been developed. One such technique is the measurement of the Near Infrared Spectra emitted onto the material. According to [7], near infrared (NIR) spectroscopy technology is a technology that can replace conventional methods, and has been successfully applied to agricultural, pharmaceutical, petrochemical, and environmental products. According to [8], NIRS method can be used to analyze the quality of the material feed with a very fast and performed non destructively, even without touching the product.

According to [1], spectral data near infrared to this day can not be utilized to determine the relationship of the chemical properties of the material being measured. The activity of relating the chemical properties of the material being measured is known as the calibration method. The calibration method that is often used is the linear regression method. The weakness of this method is the assumption of the relationship between the spectra with the nutrient content of the material, are linear. On the other hand, this assumption does not apply to all materials.This has the potential to cause a high deviation between the actual nutrient content and the estimated results.

One of the potential calibration methods to overcome these weaknesses is the Artificial Neural Network (ANN) method. JST is a method of analysis of men iru brain's ability to process the signal delivered by the nerves in the human senses. ANN consists of nodes which are composed of input layer, hidden layer, and output layer. The input layer functions as an input receiver, while the output layer functions as a container for the output of the system. The nodes in the hidden layer can facilitate a non linear relationship between input and output, so this method is able to predict more flexibly [10].

Based on the description above, the use of ANN is thought to be able to predict feed ingredients more accurately than linear regression. Therefore, it needs to do its research on the estimation of the content of dry matter and crude fiber rice bran using Artificial Neural Network (ANN) based on the data of absorbance NIRS (*Near Infrared Reflectance Spectroscopy*).

II. MATERIALS AND METHODS

Material

The material used in the study was 60 samples of rice bran obtained from 60 rice milling in West Sumatra.

Method

Capturing Samples

Samples of rice bran used in this study with a weight 500 gram at each location.

Scanning NIRS

The NIR spectra data of rice bran were obtained using a Fourier transform near infrared (FT-NIR) tool based on [8].

Analysis of Rice Bran Chemical Composition

a. Drying Material Measurement (%)
   1. Weighing a porcelain plate that has been dried at 110°C for 1 hour which is then cooled in a desiccator for 15 minutes (A).
   2. Weighing the sample into a porcelain dish as much as 1 gram (B).
   3. Weighing the porcelain plate containing the sample, which has been dried for 8 hours at 110°C and has been cooled in a desiccator for 15 minutes (C).

Calculation of water content uses the following formula:

$$KA = \frac{A+B-C}{B} \times 100\%$$

BK = 100% - KA

Information:

KA : Water concentration (%)
A : Weight of the porcelain cup (gram)
B : Sample weight (gram)
C : Weight of the porcelain dish containing the sample after oven (gram)
BK : Content of dry matter (%)

b. Crude Fiber Measurement (%)
   1. Weighing filter paper that has been dried for 1 hour at a temperature of 110˚C and cooled in a desiccator for 15 minutes (A).
   2. Weighing the sample as much as 1 gram (B).
   3. Enter the sample into a 250 ml beaker.
   4. Adding 100 ml of H_2SO_4 0.3 N to the sample.
   5. Heating the sample mixture for 40 minutes at a temperature of 100˚C.
   6. Rinse the sample with 100 ml hot water which is placed on the filter paper.
   7. Fold the filter paper with the sample on it and insert it into the beaker.
   8. Adding NaOH 0.3 N as much as 100 ml into the beaker.
   9. Heat the beaker for 40 minutes at a temperature of 100˚C.
   10. Rinse the sample with 150 ml hot water which is placed on a weighed filter paper.
   11. Rinsing the sample again using acetone as much as 25 ml.

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12. Fold the filter paper containing the sample.
13. Dry filter paper for 6 hours at a temperature of 110.
14. Weighing filter paper that has been cooled for 15 minutes in a desiccator (C).
15. Burning filter paper containing the sample using a furnace for 4 hours at a temperature of 600˚C.
16. Cool the sample ash into a desiccator for 15 minutes.
17. Weighing the cooled sample ash in a desiccator (D).

Calculation of crude fiber using the formula:

$$SK = \frac{C-D-A}{B} \times 100\%$$

Information:

SK : Crude Fiber (%)
A : Weight of filter paper (gram)
B : Sample weight (gram)
C : Weight before planting (gram)
D : Weight after being planted (gram)

calibration

Calibration aims to determine the relationship between Near infrared spectra data and the nutritional content of rice bran. The number of samples used for calibration was 40 samples.

a. Pre treatment data

The result of NIR spectroscopy data is the reflectant value (R). The reflectant values were converted to absorbance values using Log (1/R). Pre treatment is done to reduce outliers and noise data, with the normalize method using Unscrambler software.

b. Treatment data

Data treatment is the data preparation stage so that the data can be processed by using the ANN model test. This data treatment consists of reducing the input data variables and normalizing the data. Reducing the number of variables aims to avoid overfitting while data normalization aims to align data input and output according to the existing data range. Metode using Principal Components Analysis (PCA) contained in the software IBM SPSS Statistics 21. The results of PCA data are some of the main components that are used as ANN input data.

c. ANN Training

This ANN training aims to obtain weighted correlation values between each node in each layer. The weighted values are then used to estimate the dry matter content and crude fiber of the rice bran at the time of validation.

d. Statistic Analysis

The performance of the calibration results is measured by Standard Error Of Calibration (SEC). Calibration statistical analysis is calculated using the following formula:

$$SEC = \sqrt{\frac{\sum (Xa - Xp)}{n}}$$

Information:

SEC : Standard Error Of Calibration (%)
Xa : Laboratory test result value (%)
Xp : Estimation result (%)
n : Number of samples for calibration

Validation

Validation aims to test the ability of ANN in estimating the nutritional content of rice bran. The sample used for validation is 20 samples. The results of PCA data together with weighting values are used to estimate the nutritional content of rice bran. The standard error of prediction (SEP) and coefficient of variation (CV) values are used to see the success parameters.

Validation statistical analysis can be calculated using the following formula:

$$SEP = \sqrt{\frac{\sum (Ya-Yp)}{n}} \qquad CV = \frac{SEP}{y} \times 100\%$$

Information :

SEP : Standard error prediction (%)
Ya : Reference Value
Yp : Estimated results
n : Number of samples for validation
CV : Coefficient of diversity
y : Average value of sample chemical composition (%)

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Place and time of research

This research was conducted at the Laboratory of Non Ruminant Nutrition, Faculty of Animal Science, Andalas University, Padang.

III. RESULTS AND DISCUSSION

Rice Bran NIRS Absorbance Data

The data from the measurement results of the NIR Spectroscopy tool are in the form of reflection or reflectance data. Furthermore, the reflectant data is transformed into absorbance data using the Log 1/R formula. In this study Data reflectance NIRS obtained from each sample different rice bran. This can be seen at the waves of the absorbance spectrum. According [11], every substance (biological material) has a specific NIR spectrum, so that if the two samples tested have different chemical and physical compositions, a difference will be seen in the NIRS spectrum.

NIRS measurements were carried out with a wavelength of 1000-2500 nm. The results of the NIR absorbance spectrum for rice bran are presented in Figure 1. Based on Figure 1, the peaks of the NIR absorbance spectrum show that there are several gaps that are far apart, this indicates that there are outliers of the data. Therefore it is necessary to pre treatment data by normalizing it using the unscramble application. The results of the pre treatment data are presented in Figure 2.

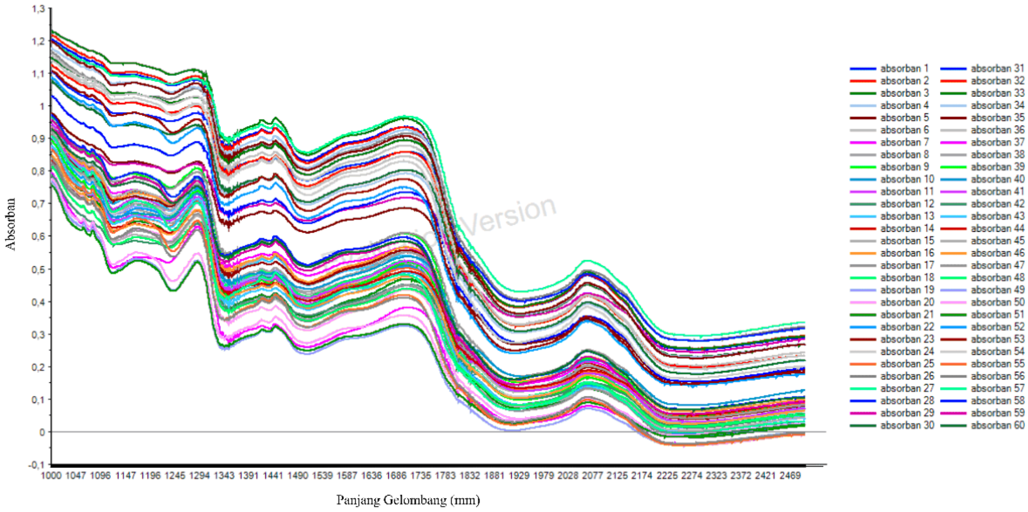

Figure 1. Graph of the NIRS absorbance spectrum for rice bran in the 1000-25000 nm wavelength.

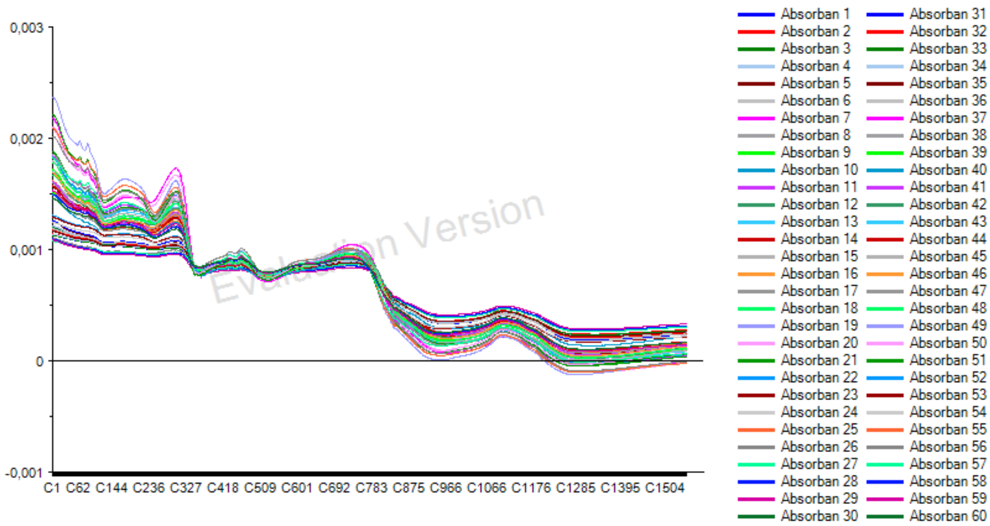

Figure 2. Graph of NIRS absorbance spectrum of rice bran with Normalize pre treatment

Based on Figure 2, NIR absorbance spectrum of the rice bran after conducted pre treatment normalize looks more meetings. This shows that normalize pre treatment can reduce outlier data. NIR absorbance spectrum value of rice bran without pre treatment ranged from 0.8 to 1.25, while after the pre treatment of data to normalize values ranging between 0.001-0.0025.

The difference in the absorbance value at each wavelength indicates a difference in the chemical composition of rice bran. The greater the content of an ingredient, the greater the absorption is carried out. On the NIR absorbance spectrum curve of rice bran, it can be seen that the peak waves occur at wavelengths of 1000 nm-1047 nm, 1245 nm-1294 nm, 1391 nm, 1441 nm, 1668 nm-1736 nm, and 2028 nm-2077 nm.

According [9], the characteristics of absorption spectra for fat are related to the presence of CH alpha groups, dry matter is related to the absorption of the –OH group, crude protein is related to the absorption of the NH group, crude fiber is related to the absorption of the –CH and –OH groups in the sample. .

In general, absorption peaks occur due to chemical bonds involving carbon, oxygen, and hydrogen frameworks, which are components of the molecular structure of rice bran. However, specifically the absorption peaks have not shown the chemical content of rice bran accurately.

Data on Rice Bran Nutrition Content with Laboratory Analysis

Rice bran is a byproduct of separating rice and husks. Rice bran is one of the feed ingredients that are widely used by breeders in the preparation of poultry and ruminant rations. The diversity of the nutritional content of rice bran is influenced by several factors, including rice varieties, the rice milling machine used, physical conditions (coarse and fine), and when milling rice bran is mixed with husks. According [5], the large and small nutritional content of rice bran is caused by different rice varieties and physical conditions.

In this study, samples of rice bran were taken from 60 different rice milling locations in West Sumatra, including rice milling in Kota Padang, Sijunjung, Solok City, Solok Regency, Padang Panjang City and West Pasaman Regency. This is what causes the nutritional content of rice bran to vary widely.

Table 1. Results of Laboratory Analysis of Rice Bran

Composition	Average (%)	Standard Deviation (%)	Maximum (%)	Minimum (%)
Dry Material	92.6	1.63	95.37	87.99
Crude Fiber	23.88	6.4	36.1	11.26

Based on Table 1, the analyzed nutritional content of rice bran yields an average dry matter of 92.60% ± 1.63% and crude fiber of 23.88% ± 6.40%. The standard deviation value for dry matter shows that the level of diversity of rice bran dry matter in each sample is less varied.

The dry matter content of rice bran in this study is higher than the national standard on rice bran for animal feed [12]. According [12], the quality requirements of rice bran for animal feed ingredients have a maximum water content of 13.0% or a minimum dry matter of 87%. The fiber content of rice bran root in this study has a high variation value with a standard deviation of 6.40%. In addition, the crude fiber content in this study is below the quality standards set by [12]. [12] states that the maximum crude fiber content in rice bran for animal feed is 12.0-18.0%.

Principal Component Analysis (PCA) Results

The absorbance spectrum obtained from the NIRS before being used as ANN input, is first performed data reduction to avoid overvitting problems and also to eliminate data intercorrelation as ANN input. The method used to reduce data is Principal Component Analysis (PCA). According [6], that principal component analysis (PCA) is one of the features of the extraction (reduction) of a variable that is widely used. In addition, PCA is the most popular analysis of multivariate statistical techniques.

The working principle of PCA is to extract all data into several main components but does not waste useful information [1]. In this study, the PCA method processing was carried out in IBM SPSS Statistic 21 by extracting the NIRS absorbance data from 1557 variables into 3 main components which were then used as ANN input. The variation data and cumulative variation data for the main components of the NIRS absorbance value can be seen in Table 2.

Table 2. Data of variation and cumulative variation of the main components of the NIRS absorbance value.

Number of PCs	Variation (%)	Cumulative Variation (%)
1	74.09	74.09
2	3.76	77.85
3	1.75	79.59

Table 2 shows that the first main component in the absorbance data already contains 74.09% of the data variation, while the second main component contains 3.76% of the data variation, and the third main component contains 1.75% of the data variation. The proportion of data variation is getting smaller for the next main component. Meanwhile, the highest cumulative variation data was found in the third main component which reached a value of 79.59%. According [3], the number of PC needed to be used as an estimator variable can not be determined absolutely, because it is different for each case. Based on this, this study conducted an experiment using the number of PCs ranging from 2 to 3 PCs.

Results of the Estimation of Dry Material Content of Rice Bran Using ANN.

The results of ANN calibration data in determining the dry matter content of rice bran showed that the increase in the main component (PC) as ANN input resulted in a decrease in the SEC value (Table 3). According [1], with the increasing number of PCs, the number of variations in near infrared absorption that is represented is increasing so that the pattern of the calculation results is closer to the actual value.

Estimation of dry matter content of rice bran with PCA input results seen from the effect of the number of PC, the number of iterations and the number of nodes in the ANN hidden layer on SEC (%) and CV (%) can be seen in (Table 3) shows the results of using the number of 2 PCs and the number of 3 PCs against the SEC there are differences. The use of 3 PCs has a lower SEC (%) value compared to the use of 2 PCs, this shows that the use of 3 PCs is better close to the actual value.

Table 3. Effect of number of PCs, number of iterations and number of nodes in the ANN hidden layer on SEC (%) Calibration and CV (%) dry matter of rice bran.

Number of PCs	Number of Iterations (000)	Number of Nodes in ANN Hidden Layer							
		3		5		7		9	
		SEC	CV	SEC	CV	SEC	CV	SEC	CV
		%							
2 PCs	25	1.31	1.41	1.31	1.41	1.31	1.41	1.31	1.41
	30	1.31	1.41	1.31	1.41	1.31	1.41	1.31	1.41
	35	1.31	1.40	1.31	1.41	1.31	1.40	1.31	1.41
	40	1.31	1.40	1.30	1.40	1.31	1.40	1.31	1.41
	45	1.31	1.40	1.31	1.40	1.31	1.40	1.30	1.40
	50	1.31	1.41	1.30	1.40	1.30	1.40	1.31	1.41
3 PCs	25	1.29	1.38	1.24	1.34	1.26	1.36	1.25	1.35
	30	1.24	1.34	1.27	1.37	1.27	1.37	1.13	1.21
	35	1.16	1.24	1.05	1.13	1.08	1.16	1.16	1.24
	40	1.23	1.33	1.05	1.12	1.21	1.30	1.04	1.12
	45	1.04	1.12	1.05	1.13	1.03	1.11	1.04	1.12
	50	1.03	1.11	1.04	1.12	1.04	1.11	1.02	1.09

Table 4. Effect of the number of PCs, the number of iterations and the number of nodes in the ANN hidden layer on SEP (%) Validation and CV (%) dry matter of rice bran.

Number of PCs	Number of Iterations (000)	Number of Nodes in ANN Hidden Layer							
		3		5		7		9	
		SEP	CV	SEP	CV	SEP	CV	SEP	CV
		%							
2 PCs	25	2.27	2.47	2.27	2.48	2.27	2.47	2.27	2.48
	30	2.27	2.48	2.27	2.48	2.27	2.48	2.27	2.47
	35	2.27	2.48	2.27	2.48	2.27	2.48	2.27	2.48
	40	2.27	2.48	2.28	2.49	2.28	2.48	2.27	2.48

	45	2.27	2.48	2.27	2.48	2.27	2.48	2.28	2.49
	50	2.27	2.48	2.28	2.48	2.28	2.49	2.27	2.48
3 PCs	25	2.26	2.46	2.23	2.43	2.24	2.45	2.23	2.44
	30	2.22	2.43	2.25	2.45	2.25	2.45	2.16	2.35
	35	2.16	2.36	2.20	2.40	2.16	2.35	2.18	2.37
	40	2.22	2.42	2.24	2.45	2.19	2.39	2.23	2.43
	45	2.19	2.39	2.19	2.39	2.24	2.45	2.19	2.39
	50	2.27	2.47	2.25	2.45	2.27	2.47	2.25	2.45

The use of a total of 2 PCs with the number of nodes in the hidden layers of ANN 3, 5, 7, and 9 and the number of iterations of 25000, 30000, 35000, 40000, 45000, and 50000, there is an SEC value of 1.30-1.31% with CV 1.40-1.41%. The SEC value using the number of 3 PCs, the number of nodes in the hidden layer of ANN 3, 5, 7, and 9, and the number of iterations of 25000, 30000, 35000, 40000, 45000, and 50000 have various values, namely 1.02-1.29% with CV 1.09-1.38%. From Table 3, the lowest SEC value is found in the number of PCs 3 nodes 9, the number of 50000 iterations with SEC values 1.02% and CV 1.09%.

The SEC value tends to decrease with the addition of the number of iterations. Each iteration occurs a weighted value adjustment based on the difference between the estimated value and the actual value. Meanwhile, the increase in the number of nodes in the ANN hidden layer did not show a pattern of decreasing or increasing SEC value. According [1], the difference in the SEC value obtained is thought to be caused by the random value at the initial weight, not due to the influence of the linearity of the relationship between PC and water content. The weights obtained during training are used to make estimates during validation.

The validation results show that the addition of the number of PCs can reduce the SEP value. Table 4 shows that the SEP value with the number of 3 PCs is lower than the number of 2 PCs. Meanwhile, the increase in the number of nodes in the hidden layer and the increase in the number of iterations tends to decrease and increase the SEP value randomly.

The SEP value on the number of 2 PCs with the number of nodes in the hidden ANN 3, 5, 7, and 9 and the number of iterations of 25000, 30000, 35000, 40000, 45000, and 50000 is 2.27-2.28% with CV 2.47-2.49%. While the SEP value on the number of 3 PCs with the number of nodes in the hidden layer of ANN 3, 5, 7, and 9 and the number of iterations of 25000, 30000, 35000, 40000, 45000, and 50000 ranged from 2.16-2.27% with CV values ranging between 2.36-2.47%.

The lowest SEP and CV values determine the best results and are closer to the actual value. In accordance with the opinion of [4] the smallest SEP and CV values show the best results. In the estimation of dry matter content of rice bran, the lowest SEP and CV values were found at 3 PCs, 30000 iterations and the number of nodes in the hidden layer of ANN 9 with SEP values of 2.16% and CV 2.36%, the same SEP and CV values were found also on 3 PCs, 35000 iterations and the number of nodes in the hidden layers of ANN 3 and 7. The estimation results of ANN based on the main components using the PCA method to estimate the dry matter of rice bran are feasible to apply with results that are close to the actual value, as evidenced by a low CV value. that is 2.36%.

The results of the estimation of the crude fiber content of rice bran using ANN.

The best estimation results and closer to the actual value can be seen in the lowest SEC, SEP and CV values. Estimation of crude fiber content using ANN can be seen from the effect of the number of PCs, the number of iterations and the number of nodes in the ANN hidden layer on the SEC (%) and CV (%) values can be seen in Table 5.

Table 5. Effect of PC number, number of iterations and number of nodes in the ANN hidden layer on SEC (%) Calibration and CV (%) crude fiber of rice bran.

Number of PCs	Number of Iterations (000)	Number of Nodes in ANN Hidden Layer							
		3		5		7		9	
		SEC	CV	SEC	CV	SEC	CV	SEC	CV
		%							
2 PCs	25	4.83	19.97	4.83	19.95	4.83	19.96	4.83	19.96
	30	4.83	19.97	4.83	19.94	4.82	19.94	4.83	19.94

	35	4.83	19.97	4.82	19.94	4.82	19.90	4.82	19.93
	40	4.82	19.91	4.82	19.94	4.82	19.92	4.83	19.96
	45	4.83	19.96	4.82	19.92	4.82	19.91	4.83	19.96
	50	4.83	19.97	4.81	19.88	4.81	19.87	4.83	19.94
3 PCs	25	4.73	19.55	4.34	17.95	4.34	17.94	4.37	18.04
	30	4.56	18.85	4.57	18.87	4.19	17.33	4.30	17.76
	35	4.31	17.83	4.32	17.85	4.31	17.80	4.04	16.71
	40	4.33	17.91	4.29	17.74	4.29	17.71	4.29	17.73
	45	4.32	17.87	4.25	17.56	4.28	17.68	4.29	17.72
	50	4.18	17.28	4.21	17.38	4.12	17.02	4.26	17.58

Calibration is the relationship between the values of the main components and crude fiber content which is carried out by training the ANN model. The ANN models tested were the number of nodes in the hidden layer, namely 3, 5, 7, and 9 vertices. The simulated data input is 2 PCs and 3 PCs, and the number of iterations is 25000 to 50000 with an interval of 5000. The training results show that increasing the number of PCs can reduce the SEC value, while increasing the number of iterations and increasing the number of nodes in the ANN hidden layer gives a change in the SEC value. are random (Table 5). The decrease in SEC with the increase in the number of PCs is due to the many dimensions that form the pattern of the relationship between the ANN input and output, so that the calculation results are only suitable for the calibration sample.

Based on Table 5, it shows the results on the 2 PC data input have a higher SEC value compared to the use of 3 PCs. This shows that the use of 3 PC data input has a value that is better close to the actual value.

The use of 2 PC data input with the number of nodes in the hidden layer ANN 3, 5, 7, and 9 and the number of iterations of 25000, 30000, 35000, 40000, 45000, and 50000 there are almost the same SEC values, namely 4.81-4.83% with CV 19.87-19.97%. Meanwhile, the SEC value with the use of 3 PCs, the number of nodes in the hidden layer of ANN 3, 5, 7, and 9, and the number of iterations of 25000, 30000, 35000, 40000, 45000 and 50000 have various values, namely 4.04-4.73% with a diverse CV namely 16.71-19.55%.

The lowest SEC value is found in data input 3 PC node 9 with the number of 35000 iterations with a SEC value of 4.04% and a CV value of 16.71%. The difference in SEC value is thought to be caused by the initial weighted random value. The weights obtained during the ANN training are used to estimate the validation sample to obtain the SEP value. Meanwhile, changes in CV value can be caused by the average actual value. The effect of the number of PCs, the number of iterations and the number of nodes in the ANN hidden layer on SEP and CV of crude fiber of rice bran can be seen in Table 6.

Table 6. The effect of the number of PCs, the number of iterations and the number of nodes in the ANN Hidden layer on SEP (%) validation and CV (%) crude fiber of rice bran.

Number of PCs	Number of Iterations (000)	Number of Nodes in ANN Hidden Layer							
		3		5		7		9	
		SEP	CV	SEP	CV	SEP	CV	SEP	CV
		%							
2 PCs	25	2.22	9.28	2.26	9.46	2.27	9.50	2.27	9,52
	30	2.22	9.31	2.26	9.45	2.25	9.43	2.27	9.50
	35	2.20	9.22	2.26	9.48	2.26	9.48	2.27	9,51
	40	2.25	9.42	2.26	9.45	2.27	9.50	2.27	9,52
	45	2.20	9,20	2.28	9,55	2.24	9.39	2.27	9,51
	50	2.22	9.31	2.29	9,59	2.26	9.47	2.27	9.50
3 PCs	25	1.97	8.23	1.54	6.45	1.57	6.59	1.51	6.32
	30	1.43	5.98	1.47	6.15	1.62	6.79	1.74	7.29
	35	1.71	7,16	1.64	6.88	1.62	6.79	2.08	8.70
	40	1.77	7.41	1.59	6.64	1.61	6.75	1.65	6.89

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45	2.11	8.84	1.63	6.84	1.59	6.65	1.58	6.62
50	1.84	7.68	1.74	7.28	1.87	7.82	1.63	6.84

Based on Table 6, it shows that increasing the number of PCs can reduce the SEP and CV values, while the number of iterations and the number of nodes in the hidden layer of ANN does not consistently increase or decrease the values of SEP and CV (random).

SEP value of rice bran crude fiber with 2 PC input, the number of nodes in the hidden layers of ANN 3, 5, 7, and 9 and the number of iterations of 25000, 30000, 35000, 40000, and 50000, namely 2.20-2.29% with CV ranged from 9.20-9.59%. While the SEP value with the input of 3 PCs, the number of nodes in the hidden layers of ANN 3, 5, 7, and 9 and the number of iterations of 25000, 30000, 35000, 40000, 45000, and 50000 are very diverse, namely 1.43-2.11% with CV values ranging from 5.98-8.84%. The lowest SEP and CV values determine the best results and are closer to the actual value. In accordance with the opinion of [4], the smallest SEP and CV values show the best results.

The estimation results of the crude fiber content of rice bran with the lowest SEP and CV values were found in the use of 3 PC input, 30000 iterations and the number of nodes in the hidden layer of ANN 3 with a SEP value of 1.43% with a CV value of 5.98%. Based on the CV value at the time of validation, it can be seen that the estimation of crude fiber content of rice bran using ANN using the PCA method can predict up to 94% close to the actual value

IV. CONCLUSION

Based on the research results, it can be concluded that the best results in estimating dry matter content and crude fiber of rice bran using ANN is seen from the lowest SEC, SEP and CV values. The results of the estimation of dry matter have SEC values of 1.02%, SEP values of 2.16% and CV of 2.36%, while the results of the estimation of crude fiber have SEC values of 4.04%, SEP values of 1.43% and CV values of 5.98 %.

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