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Analysis and Comparing Forecasting Result Using Time Series Method to Predict Sales Demand on Covid -19 Pandemic Era

Paduloh Paduloh[1*], Abdul Ustari[2]

[1,2]*Industrial Engineering Program Study, Bhayangkara Jakarta Raya University, Bekasi,17121, Indonesia*
E-mail: paduloh@dsn.ubharajaya.ac.id.

Abstract: *The Covid-19 pandemic has made uncertainty in demand very high; there have been many changes in demand due to changes in the market and people's buying methods. So that forecasting accuracy is significant for every industry, at least the forecast that is closest to the conditions faced by the company so that the company does not lose money due to forecasting errors. Time series is a widely used model for forecasting using past data. This study aims to minimize forecasting errors by analyzing which demand forecasting model is most suitable for demand conditions based on historical data on demand for masterbatch products. The method used in this study is a time series model, which consists of the season naive method, holt exponential smoothing, exponential triple smoothing, and autoregressive integrated moving average (ARIMA). Data processing is done using Rstudio software. The results show that the ARIMA method (2,1,0) (1,1,0) is the best because it has the smallest error rate value with case studies and exact data; the standard error size values used are ME, RMSE, MAE, MPE, MAPE, MASE, and ACF1. This study analyzes forecasting during the Covid-19 pandemic using time series and compares them to find the best results. Then the results of this study can be used as a reference by companies and researchers in determining the model used to make forecasts.*
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Keywords: *Time Series, ARIMA, Masterbatch, Rstudio*

1. Introduction

The current COVID-19 pandemic has affected the industrial world, most of the industries have declined, but some have experienced a significant increase due to changes in sales, distribution, and consumption patterns. Forecasting inventory is a hot topic today, considering that every industry must have the right strategy to remain efficient to generate profits. The industry's need for forecasting accuracy is significant to fulfill, combining various methods to obtain the forecasting method closest to the company's conditions [1]. Errors in forecasting will impact many aspects, ranging from the occurrence of excess inventory and shortage of inventory which will also impact other waste, in the form of damaged products or high purchase costs because more expensive modes of transportation must import orders [2].

* Corresponding author. Email: paduloh@dsn.ubharajaya.ac.id
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All existing forecasting models can be used and can provide numbers that can be used as a reference, according to the advantages and disadvantages of the method. In this paper, we will try to analyze the forecasting results of the time series model, which consists of season naive, holt exponential smoothing, exponential triple smoothing, and autoregressive integrated moving average (ARIMA) methods to try to analyze which forecasting model is the best. Closest to actual sales or demand [3]. In this study, we continue to use historical data to determine the trend of changes in demand in the pandemic-19 condition and analyze changes based on historical data, considering that consumption in total only decreased by 10 - 30%. Significant changes only occurred in shopping patterns, from restaurant spending fell. Still, from the household side, it increased, assuming that people who previously ate in restaurants during the pandemic preferred to cook at home. This is also supported by previous research by [4][5], who found that consumption did not decrease significantly but only changed spending patterns. Time Series is a series of events or

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observations taken sequentially from time to time [6]. In the Time Series, data collection on sales of goods per month for several months in a row. Indeed, the example above is not much different from the usual statistical data if you look at the example above. However, there is one thing that makes a difference, namely the time dimension. This time dimension serves as something we commonly call a feature in the world of machine learning [7], [8]. This feature can provide many data processing and analysis uses, and we can get insights or conclusions from observations [9].

Getting forecasting numbers that are right or close to actual requires the right strategy, from analyzing data types to analyzing data and comparing actual and forecasting [10]. Comparison between actual data and forecasts needs to be done using quite long data; it takes several years to be sure the forecasts we get can predict with various conditions [11]. Sales conditions increased due to the impact of various events, increases due to the success of the sales marketing team, increases due to trends, and so on [12]. For this reason, this study tries to analyze the forecast time series method, compare and analyze which method is the closest and most appropriate, and consider the resulting error value. This research will use R software, which is statistical software capable of being used for forecasting. The results of this study will be helpful for companies to carry out inventories and minimize losses due to forecasting errors.

2. Material And Method

This study makes forecasts using historical data. It is based on the history of previous data, which means that previous data is good data for predicting the future. This method is most suitable if the basic forecasting pattern does not substantially vary from the initial year to the next year [3]. It can be called a simple method because of its implementation, which serves as an excellent first point to predict the subsequent request [13].

Previous research provides a new approach in conducting time series by utilizing profit-taking in forecasting the volume of demand by estimating the amount of production at a predetermined time, then explained in his research that the researcher chose to use the time series method using exponential smoothing [14]. Because it has a simple formula and easy to find the cause of the error. Research comparing the use of Moving Average, Exponential Smoothing, and Trend Analysis methods proves that Exponential Smoothing is the best method in making a new car sales forecasting system because it has a lower error rate [15]. Time series analysis can be assumed that the time series is divided into several components, namely Trend (T), Cycle (C), Season (S), and Horizontal, which can be an indication of a specific pattern[16]. This time series method has several models that can be used depending on the current demand pattern [3], [13][17] [18]. [5] using seasonal naive Bayes, ANN, then ARIMA, this forecast is used to reduce the impact of the bullwhip effect. Another study [19] chose the ARIMA model (1, 0, 1) and validated historical demand information with the same conditions. His research proves that the ARIMA model can be used to model and forecast food manufacturing demand.

2.1 Procedures

This research starts from identifying problems to respond to the problems that exist in the research. Then do the data collection process by collecting secondary data. The secondary data needed is masterbatch request data from January 2019 to December 2020. The next process is processing demand data by forecasting demand data in the next year and finding the smallest error value from each time series method using Rstudio software. The next process is to analyze the data, and after the data is analyzed, the next process is to determine which time series method is the best model by adjusting the demand pattern. After the data has been processed, the final result is the conclusion and suggestions.

2.2 Forecasting Formulations Based

Exponential Triple Smoothing (ETS) is a set of algorithms that process both trend and periodic (seasonal) effects. The formula for predicting with ETS is in formulation (1) below.

$$\mathbf{f}_{t+m} = {}_{t} + b_{(m)} + \frac{1}{2} c_{t(m2)} \quad (1)$$

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The exponential smoothing method is a method that shows the weighting decreases exponentially with longer observation values. One or more writing parameters are explicitly specified, and the result of this choice determines the weight assigned to the observation value. The reason for exponential smoothing is similar to that of a linear moving average where single and multiple smoothing values lag behind the actual data. Where there is a trend element, the difference between the single and multiple smoothing values can be added to the single smoothing value and adjusted for the trend. Holt's linear exponential smoothing method does not use the multiple smoothing formula directly. On the other hand, Holt smooths the trend values with different parameters from the parameters used in the actual conditions. An estimate of Holt's linear exponential smoothing is obtained using two smoothing constants (values between 0 and 1). This condition can be seen in the following equation (2), (3) and (4).

$$S_t = \alpha X_t + (1-\alpha)(S_{t-1} + b_{t-1}) \quad (2)$$
$$b_t = (S_t - S_{t-1}) + (1-\gamma)b_{t-1} \quad (3)$$
$$F_{t+m} = S_t + b_t{}^m \quad (4)$$

The Seasonal Naive method calculates seasons by determining the value of each prediction is the same as the value of the last observation that occurred in the same season. For example, the predicted value made in April will be the same as the previously observed value for April. The formulation is in the following formulation (5) below:

$$y^t + 1 = (T+1) - k_m \quad (5)$$

The Autoregressive Integrated Moving Average model is a model that can be used by solving seasonal time series. The model has two parts: the non-seasonal and the seasonal parts. The non-seasonal part of this model is the ARIMA model [17]. This ARIMA model has several autoregressive models and moving average models. The seasonal factor is obtained in static data by identifying the autocorrelation coefficient for 2 or 3 time-lags that significantly differ from 0. A pattern in the data indicates autocorrelation, which is significantly different from 0ta. To deal with seasonality [3] [19] [17], the short standard notation is:

ARIMA (p,d,q) 〖(P,D,Q)〗 ^S

Where (p,d,q) = the non-seasonal part of the model
(P, D, Q) = seasonal part of the model
S = number of periods per season

Testing the value of the autocorrelation coefficient of the error, the examiner must see the randomness of the error value made, with one of the following two statistics [3]:

a. Q Box and Pierce test:
$$Q = n' \sum_{k=1}^{m} r_k^2 \quad (6)$$

b. Ljung-Box Test:
$$Q = {}'(n'+2)\sum_{k=1}^{m} \frac{r_k^2}{(n^F-k)} \quad (7)$$

Spreads Chi-Squarely *(2* X^2*)* with degrees of freedom *(db)=(k-p-q-P-Q)* where:
n' = n-(d+SD)
d = the order of differentiation is not a seasonal factor
D = order of differentiation of seasonal factors
S = number of periods per season
m = maximum time lag
r^k = autocorrelation for time lag 1, 2, 3, 4..., k

The available time-series data are mostly non-stationary. Several things cause time series data not to be stationary, namely the mean and variance. For example, *Wt* is the difference sequence with *W_t=Y_t-Y_(t-1)*, then the ARIMA process can be written:

$$W_t = \phi_1 W_{t-1} + \cdots + \phi_p W_{t-p} + a_t - \theta_1 a_{t-1} - \cdots - \theta_q a_{t-q} \quad (8)$$

Suppose *Wt* is changed to *Y_t-Y_(t-1)*, it means that can write the following equation as:

$$Y_t = Y_{t-1} + \phi_2(Y_{t-1} - Y_{t-2}) + \cdots + \phi_p(Y_{t-p} - Y_{t-p-1}) + a_t - \theta_1 a_{t-1} - \cdots - \theta_q a_{t-1} \quad (9)$$

Measurement of forecasting accuracy means measuring the error rate of the actual demand forecasting results.

2.3 Forecasting Results Accuracy Measure

A measure of the accuracy of forecasting results is the level of difference or error in forecasting results with actual demand. There

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are several sizes commonly used. Namely, Mean Absolute Demand (MAD) [11] [20] [17] is the average absolute error over a certain period regardless of whether the forecast results are larger or smaller than the reality. Systematically, MAD is formulated as follows: At = Actual demand in period t, Ft = Forecasting demand in period t, and n = number of forecasting periods involved.

$$MAD = \sum \left| \frac{A_t - F_t}{n} \right| \tag{10}$$

Mean Square Error (MSE) is calculated by adding the squares of all forecasting errors in each period and dividing by the number of forecasting periods. Systematically, MSE is formulated in formula (11) as follows.

$$\text{MSE} = \sum \frac{(A_t - F_t)^2}{n} \tag{11}$$

Mean Forecast Error (MFE) [21], [22]–[24] is very effective in determining whether a forecasting result is too high or low during a certain period. If the forecasting results are not biased, then the MFE value will approach the note. MSE is calculated by adding up all forecasting errors during the forecasting period and dividing by the number of forecasting periods. It is systematically formulated in (12) as follows.

$$\text{MFE} = \sum \frac{(A_t - F_t)}{n} \tag{12}$$

It is a measure of relative error. MAPE is usually more meaningful than MAD because MAPE expresses the percentage of forecast error to actual demand over a certain period, giving information on the percentage error being too high or low. MAPE is generally used more than MAD because MAPE displays the percentage error value of forecasting results to actual demand during a certain period which will provide information on the percentage of error that is too high or low [17]. The formula is formulated in (13) below.

$$\text{MAPE} = \left(\frac{100}{n}\right) \sum \left| A_t - \frac{F_t}{A_t} \right| \tag{13}$$

.Root Mean Square Error (RMSE) is the number of squared errors or the difference between the actual value and the predicted value that has been determined. The RMSE formula is as follows: Y' = Predicted Value, Y = Actual value, and n = Number of Data.

$$\text{RMSE} = \sqrt{\sum \frac{(\text{F}^F - \text{F})^2}{n}} \tag{14}$$

MAE shows the average value of the error, the error of the qual value with the predicted value. MAE itself is generally used to measure prediction errors in time series analysis. With the following (15) equation:

$$\text{MAE} = \sum \frac{|\text{F}^F - \text{F}|}{n} \tag{15}$$

ME is the average error value of the actual value. ME serves to predict the average error rate and is often used for time series methods. The ME formula follows, with e_t = Forecasting error in period t, X_t= Actual value in period t, and f_t= Forecasting value in period t.

$$e_t = \text{X}_t - \text{f}_t \tag{16}$$

Mean Percentage Error (MPE) is used to determine whether a forecast is biased or not. If a technique produces an unbiased forecast, then the MPE will produce a percentage close to 0. If the MPE is negative and large enough, this forecasting method will produce a high forecast and vice versa. The MPE formulation is defined in formula (17) as follows.

$$\text{MPE} = \frac{\sum_{=1}^{n} \left(\frac{Yt - Yt}{Yt}\right)}{n} \tag{17}$$

3. Case Study

The chemical raw material manufacturing industry, especially plastics, is one sector that provides the largest contribution to high growth and becomes a supply chain for consumer products. The performance of the plastic chemical industry sector is determined by the large use of goods made of plastic so that the growth of the plastics industry soars and the potential is still large. In everyday life, the use of plastic has spread to almost all areas of life. The advantage of using plastic as a material for products is that this material is more economical, flexible, not easily broken, and lighter.

One company that produces plastic

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chemical raw materials is Polycolor Prima Perkasa. The products produced are masterbatch and powder, which we know as plastic dyes. With extensive experience and knowledge, Polycolor Prima Perkasa products are designed to meet specific requirements. The products produced are made of polymers, such as PE, PP, HIPS, ABS, Nylon, and others. The production system at Polycolor Prima Perkasa is based on make-to-order and make-to-stock. Aligning the system, the company needs to provide a stock of demand supplies to anticipate the demand that cannot ascertain. The demand for masterbatch products increases every year. Must prepare The more demand for current products, the more raw materials supplies to carry out the production process.

The researcher collects data based on the data needed, namely the masterbatch request data in the company. Sample data taken starting from 2013 to 2020 can be seen in Table 1.

Table 1. Masterbatch Request Table January 2013 - December 2020.

Period	2013	2014	2015	2016	2017	2018	2019	2020
January	60925	54804	41300	61970	50611	88320	94028	110603
February	28004	43394	61185	121580	92941	69615	78562	94700
March	51430	47442	71785	80600	70587	62422	91445	143167
April	35242	49698	69390	83960	45307	74908	60855	67818
May	50390	33376	51562	61430	60182	82344	104723	17953
June	41195	68605	51148	77378	33749	44815	57025	90886
July	54442	39883	34390	34411	63475	85610	102787	103088
August	31362	49594	73438	71402	64990	101753	88953	84701
September	56943	60285	58838	58153	67073	67575	94973	126924
October	44478	45980	57474	60680	107145	99291	77072	78715
November	47656	31150	73018	69121	72274	82888	96168	116806
December	31383	82268	57980	86526	90761	71740	89500	65394

3.1 Data Pattern Test

In this study, the data pattern test was carried out using the Rstudio software to determine the movement pattern of masterbatch product demand. The results of the data pattern test can be seen in the image below.

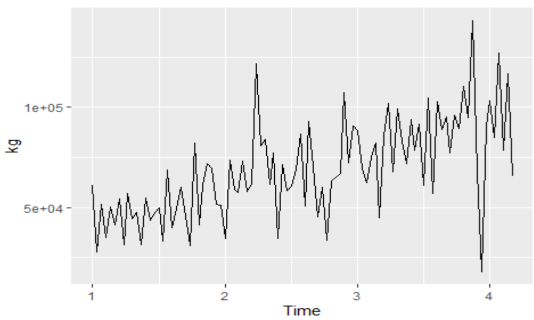

Fig. 1. Masterbatch Request Graph

Based on the results of the pattern test in Figure 1, namely the data that has been carried out, it can be said that there is no data certainty because the data pattern is stationary if the graph contains data that fluctuates around a constant average value.

3.2 Processing And Data Analysis

At this stage, the researcher will manage and analyze the data from calculating the forecasts for each time series model, find the smallest error value for each model, and determine which forecasting model is the best. Forecasting aims to estimate product needs in the future. Forecasting in this research is for the next year because if it is done with a short period, the accuracy of the forecasting results is considered less accurate. The data used for forecasting is masterbatch product demand data from January 2013 – December 2020. In this study, the forecasting method uses the time series method with the following models: seasonal naive, Holt exponential smoothing, autoregressive integrated moving average (ARIMA), and exponential triple smoothing. The results of this research will be determined with the smallest error value, and the research is carried out using the Rstudio software.

3.2.1 Seasonal Naive

After processing the data with the seasonal naive model formula equation in formula 2.15, it produces forecasting for the next period using Rstudio software. The following are the results of calculations using the seasonal naive model.

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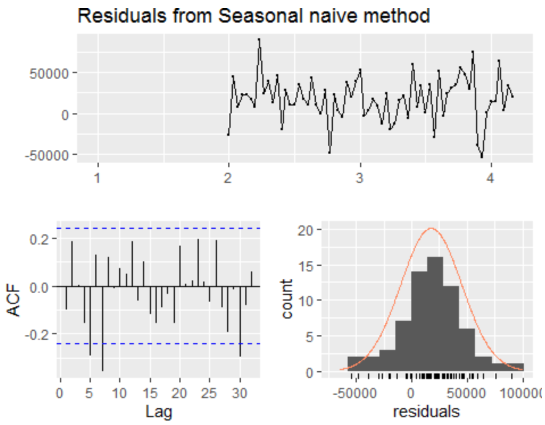

Fig. 2. The residual of Seasonal Naïve method

Ljung-Box test data: Residuals from Seasonal naive method Q* = 34.566, df = 19, p-value = 0.01574, Model df: 0. Total lags used: 19 Represents a large challenge to improving the fishing industry [4].

Thus, researchers have aimed to diversify the feedstock of milkfish, considering the nutritional value, raw material quality, and pricing of the feed. For example, by modifying the formulation of fish fodder using soy and tofu waste, Aslamsyah (2009) demonstrated a reduction in costs without impeding milkfish growth [5]. Similarly, the production of milkfish food using worm flour as a partial substitute for fish flour demonstrated similar results [6]. Maggot flour has also been experimentally demonstrated as a protein substitute for fish flour in milkfish fodder [7]. Snails are commonly associated with household pests and have rarely been used in the production of fish fodder. However, snail flour has a composition of 59.27% protein, 3.62% fat, 2.47% crude fiber, 6.4% calcium, and 0.85% phosphorus [8]. In an effort to introduce alternative fish fodder, demonstrated that the feedstock of red parrotfish could be substituted by snail flour up to 50%. There is no explanation about the composition of each ingredient to produce fish food, particularly for milkfish.

Table 2. Forecasting Results For The Next Period Using Naive Seasonal Model

Period	Forecast	Lo 80	Hi 80	Lo 95	Hi 95
January	85610	43997.95	127222.05	21.969.857	149250.1
February	101753	60140.95	143365.05	38.112.857	165393.1
March	67575	25962.95	109187.05	3.934.857	131215.1
April	99291	57678.95	140903.05	35.650.857	162931.1
May	82888	41275.95	124500.05	19.247.857	146528.1
June	71740	30127.95	113352.05	8.099.857	135380.1
July	94028	52415.95	135640.05	30.387.857	157668.1
August	78562	36949.95	120174.05	14.921.857	142202.1
September	91445	49832.95	133057.05	27.804.857	155085.1
October	60855	19242.95	102467.05	-2.785.143	124495.1
November	104723	63110.95	146335.05	41.082.857	168363.1
December	57025	15412.95	98637.05	-6.615.143	120665.1

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This work therefore aims to determine the best composition of the ingredient of fish fodder. The composition of common milkfish feedstock is first investigated to determine the nutrient requirements. There were five kinds of compositions as treatment and proximate test held to know the compositions of water, ashes, protein, fat, crude fabric, BETN, digestible energy (DE), and C/P.

Literature review

Fodder refers to the food provided to livestock and is categorized as high-grade when having a high protein content and containing a proper balance of proteins, fats, carbohydrates, and vitamins. When purchasing fodder, the storage time and method must be considered in addition to the quality, as most fodders expire within 2 weeks, and must be kept dry and stored in airtight containers to prevent spoilage or fungus growth. Additionally, the type of fodder must be considered, whether natural or synthetic. Synthetic fodders are made fromsynthetic materials and are alkaline in the form of pasta and emulsion. Wet fodders often expire quickly and thus should be usedin a single feeding, although they can be stored in a cold environment for up to 3 days. The storage of fodder exceeding the recommended expiration date decreases the quality and increases the likelihood of spoilage. Overall, the raw material used in fodder must meet several requirements, including the nutritional value, ease of digestion, poison content, easy to get, and not primary needs for human.

Synthetic fodder used for milkfish consists of several ingredients, including fishmeal and bran smooth. Fishmeal consists of dried and milled fish or parts of fish, with or without oil, and is mainly used as an ingredient in a variety of animal fodders, including chickens, pigs, and fish. High- quality fishmeal should be free from insects, fungi, pathogenic microorganisms, bones, eyes, and any other foreign substances, have asubtle uniform color, and have a distinctive "fishy" smell [9]. Bran smooth is a waste product of rice mills that acts a supporting component in synthetic food. There arerough and there were fine, both when mixed with water is rough tasted lots of fiber, otherwise smooth like porridge chewy, both can be used as animal feed ducks, additional food fish, etc.

To meet the nutritional requirements of milkfish, vitamins and minerals must also be added to synthetic fodder. Vitamins are a set of diverse organic compounds with low molecular weight (i.e., $\leq$1000) that are vital for the healthy functioning of an organism but cannot be synthesized by the body in an adequate amount. An inadequate amount of added vitamins in a synthetic feed will result in the decline of the health of the livestock. Minerals are inorganic elements that are also necessary for normal life processes. Although fish can absorb some inorganic elements from their environment, some must be added to their feedstock. As a result, a mineral mix is added to the artificial feed in the range between 2% and 5% of the total amount of raw materials, depending on the type of fish being fed.

Experimental research is a research that seeks the influence of specific variables on other variables with tight control by Design of Experiment [10]. An experimental research study is a systematic, logical, and strictness to control the condition [11]. An experimental research can be interpreted as a method used to find a specific treatment effect against the other in uncontrolled conditions [12].

Research experiments using a trial that is specifically designed to generate the data needed to answer the research question [13]. In conducting the experiment, the researchers manipulate a stimulant, treatment, or experimental conditions and then observe the effects caused by the treatment or the manipulation. The aim of this experimental study was to investigate the hypothesis proposed in the study, predicted event, or events in the experimental background and generalize the relationship between variables.

Experiments comprise two baselines. First, at least two or more conditions or methods, that used for testing effects of a certain condition or "treatment," as the independent variable. Second, the independent variable directly manipulated by researchers. There are two groups in the experimental design, namely, the experimental group and the control group.

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Both groups were as far as possible homogeneous or have similar characteristics. In the experiment given influence or treatment certain, while in control group not given. In addition, the research process is running and observed to determine the differences or changes in the experimental group.

Research methodology

To determine the best composition, a series of experiments by substituting a percentage of fishmeal with snail flour were performed, as detailed in Table 1, where each trial was performed twice. The steps of this research are as follows :

1. Determine the composition of fish feed required according to Table 1 with fish meal substituted with snail meal. The composition of fish feed was designed for five treatments with two replications.
2. Making fish feed
3. To test the chemical content in the laboratory to determine the protein content in the five compositions of fish feed.
4. Conduct chemical content tests in the laboratory to determine the energy content of the five fish feed compositions.
5. Analyzing differences in protein and energy levels in the five fish feed compositions using the Random Perfect Design method. Analyzing the effect of increasing the percentage of snail flour on the increase in protein and energy levels.

Results and discussion

Feed production test with fishmeal substitution with flour snails

Fish fodder was produced in a series of trials substituting a percentage of fishmeal with snail flour; the composition of each trialed fish fodder is detailed in Table 1, where each trial was performed twice. Changes in the composition of fish feed to determine changes in content in fish feed when fish meal is substituted with snail meal which is a control factor. Substitution of fish meal with snail flour was carried out at various levels, namely 0%, 25%, 50%, 75%, and 100%. In Table 1 it can be seen that in experiment A, fish meal was 70gram (100% of the composition of fish meal and snail flour) and without a mixture of snail flour (0%). In experiment B the composition offish meal was 52.5 grams (75%) and snail flour was 17.5 grams (25%), while in experiment C the composition of fish meal was 35 grams (50%) and snail flour was also 35 grams (50%). For experiment D, the composition of fish meal was 17.5 grams (25%) and snail flour was also 52.5 grams 75%) while in experiment E did not use fish meal (0%) and 28 gram snail flour (100%). For other ingredients such as soybean flour, bran flour, wheat flour, fish oil, vitamins, minerals, adhesives and water are fixed.

The control factor in this study was the amount of fish meal and snail meal used to determine the protein content and energy content/digestible energy (DE) in fish feed. The control factor chosen was due to limited fish resources and is a human food need. In addition, the price of fish meal is more expensive than snail flour so that snails can be used as an alternative to substitute fish meal. Replication was carried out twice with the assumption that the experimental results had the same component characteristics. The amount of fish feed made is 250gram according to the needs of the experimentscarried out. Due to the need for testing the content of fish feed in the laboratory only requires <100 grams, then the amount of fish feed of 250 grams is considered sufficient.

The snail fodder was first prepared, as presented in Figure 2, by:

1. releasing the snail meat from the shell,
2. drying the snail meat in an oven for approximately 90 min,
3. blending the dried snail meat, and sieving the blended flour.

Figure 2. Snail flour production process

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Next, the fish fodder was prepared, using the snail and soybean flour as protein, bran and polar flour as carbohydrates, fish oil as fat, and a vitamin and mineral mix. The raw materials were weighed and then blended together to form a homogeneous mixture having the smallest percentage to the highest percentage and added CMC gluten around 3%–5%.

The homogeneous blend of ingredients was knead into a printable dough that wasthen fed to a printing press to produce round, elongated noodles. These noodles were cut into smaller pieces to be fed to the fish. They were then oven-dried or sun-dried, cooled to room temperature, put in a plastic bag, labeled, and stored in a dry place. The treatment level tested in the substitution of fishmeal with snail flour in making fodder milkfish, namely: feed A: 0%, feed B 25%; feed C 50%; feed D 75% and E 100% starch feed snails. Food that has been so tested to the Faculty of Animal Nutrition Laboratory.

Table 3. Raw Material Composition of Fish Fodder Ingredient on Each Treatment.

Trial	A		B		C		D		E	
Raw Material	%	mass (g)	%	mass (g)	%	mass (g)	%	mass (g)	%	mass (g)
Fishmeal	28	70	21	52.5	14	35	7	17.5	0	0
Snail flour	0	0	7	17.5	14	35	21	52.5	28	70
Soybean flour	30	75	30	75	30	75	30	75	30	75
Bran flour	20	50	20	50	20	50	20	50	20	50
Wheat flour	18	45	18	45	18	45	18	45	18	45
Fish oil	1	2.5	1	2.5	1	2.5	1	2.5	1	2.5
Vitamin mix	2	5	2	5	2	5	2	5	2	5
Mineral mix	1	2.5	1	2.5	1	2.5	1	2.5	1	2.5
Gluten	5	12.5	5	12.5	5	12.5	5	12.5	5	12.5
Water	10	25	10	25	10	25	10	25	10	25

Note: Each treatment was 250 g

Composition of resulting synthetic feed

The nutritional composition of the synthesized milkfish fodder was analyzed; the results, summarized in Table 3, indicated that all studied trials sufficiently met the nutritional needs of the milkfish in all aspects (i.e., protein, carbohydrates, fats, vitamins, and minerals). Milkfish fodder for milkfish weighing 0.01–0.035 g requires 52%–60% of protein; those weighing 0.04 g require 40% of protein; and those weighing 0.5–0.8 g require 30%–40% of protein[14]. Thus, they need less protein in their feed as they grow. Juvenile fish require a fat and carbohydrate feedstock content of 7%– 10% and 20%–30%, respectively. The balance of protein and energy in the diet affects the growth of the fish. Protein is used mainly in the maintenance and growth of the fish by reducing the oxidation of protein into energy. This is to meet the energy needs of non-protein, suchas carbohydrates, and fats. Fodder with an optimum protein-to-energy ratio illustrates the point of balance between the amount of energy required for basal metabolism and growth. An increase in the energy content of the feed can cause the fish to consume the food at a slower pace, thus limiting their intake of other essential nutrients and reducing their growth. Instead, feed that energy shortages will cause the feed protein is used as energy for the purposes of fish metabolism. This is the basis for this study to analyze the protein content and energy content in 5 kinds of experiments carried out by substituting fish meal and snail meal for two replications.

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Table 4. The Results of Laboratory Testing

Trial	Dry Ingredients	Water Level (%)	Ash Level (%)	Organic Ingredient (%)	Rough Protein (%)	Rough Fat (%)	Rough Fiber (%)	Nitrogen-free Extract Ingredients (%)	Rough Energy(kcal/gr))
A1	93.15	6.85	12.11	87.89	27.41	10.86	11.13	31.64	2664.0
A2	94.11	5.89	13.66	86.34	25.71	12.41	12.76	29.56	2585.2
B1	92.98	7.02	11.07	88.93	23.43	8.65	8.59	41.25	2785.4
B2	94.38	5.62	11.79	88.21	24.03	9.96	11.01	37.59	2723.3
C1	89.43	10.57	13.90	86.10	26.87	9.36	7.55	31.47	2595.4
C2	90.22	9.78	13.16	86.84	22.98	10.43	8.67	34.98	2610.3
D1	94.12	5.88	12.89	87.11	22.45	9.50	11.95	37.33	2641.6
D2	94.87	5.13	11.76	88.24	22.98	9.23	9.59	41.30	2792.0
E1	92.87	7.13	10.76	89.24	29.92	10.26	8.14	33.78	2808.0
E2	94.50	5.50	11.79	88.21	24.27	9.37	7.89	41.18	2838.4

Table 5. Rough Protein Contents in Fish Feed

	Rough Protein				
Replication	A	B	C	D	E
1	27.41	23.43	26.87	22.45	29.92
2	25.71	24.03	22.98	22.98	24.27

In table 4 indicates a balance between the amount of energy and protein. Protein is used as a function of fish maintenance and growth by reducing protein oxidation into energy. This is to meet the energy needs of non-protein, such as carbohydrates and fats. From Table 4. it can be seen that the composition of milkfish feed with fish meal substitution with snail flour can be done up to 100%.

Design of experiments

Fully randomized trials were used. Through this method, the levels of crude protein and feed DE experimental results five treatments were tested to get a conclusion on whether there is a difference between the results of the five treatments.

Analysis of protein content

Analysis of a fully randomized design was conducted to prove whether treatment composition of fish feed ingredients to yield significant result toward increased levels of protein. Fifth ingredients composition was examined by replicating data capture as much as two times. Table 5 presents the grouping of replication in accordance with the composition of each.

In the fifth the energy content of the composition testing using a randomized design perfectly, with different results among the five treatments, testing is done to prove the level of significance of the difference of each fish feed. The hypothesis of this study is:
H0: No difference between the rough protein of the fifth mixture of fish feed
H1: Difference between the rough protein of the fifth mixture of fish feed

Furthermore, the calculation of the sum of squared error of observation to the sum of the squares on the experiment results. The results are summarized in Table 4. Next, the calculations Central Square (*KT*) on each resource variance according to the respective degree of freedom (df). The results of further calculations used to determine the amount of the value of F countis 1,350, which is presented in Table 6.

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Table 6. The Result of The Calculation

Symbol	Explanation	Result
Ry	Sum square observation	6252,5
PBy	Sum square mean	27,3245
∑Y2	Sum square treatment	6305,118
Ey2	Sum square errors	25,29275

Table 7. Calculation Ratio of Rough Protein Test

Source	*Dk*	*JK*	*KT*	F ratio	F Table
Mean	1	73135630	73135630		5,19
Ingredient percentage	4	66885,27	16721,32	4,94243	
Error	5	16916,09	3383,218		
Total	10				

The resulting F count was smaller than the value of F table; thus, H_0 was accepted. No significant difference was observed between through protein of the fifth mixture of fish feed better use of fishmeal and snail flour. These results can be used as a reference that the quality of fish feed ingredients pure fishmeal or snail flour mixture has the same protein content.

Analysis of energy content

Finally, the variation in energy content with the substitution of snail flour for fish meal was analyzed to determine whether additional flour as a raw material companion snail can be done in the process of making fish feed. Furthermore, analysis of randomized design perfectly done to prove whether treatment composition of feed ingredients to yield significant results to increased energy content. Fifth ingredient composition was examined by replicating data capture as much as two times. Table 6 presents a grouping of replication in accordance with the composition of each, as follows:

Table 8. Energy Content in Fish Feed

	Energy				
Replication	A	B	C	D	E
1	2664	2785,4	2595,4	2641,6	2808
2	2585,2	2723,3	2610,3	2792	2838,4

Table 9. Calculation Results

Symbol	Explanation	Result
Ry	Sum square observation	73135630
PBy	Sum square mean	66885,27
∑Y2	Sum square treatment	73219431
Ey2	Sum square errors	16916,09

Table 10. Calculation Fratio of Energy Content Test

Sumber Variansi	*Dk*	*JK*	*KT*	*F Hitung*	*F Table*
Rata-rata	1	73135630	73135630		5,19
Persentase Bahan	4	66885,27	16721,32	4,94243	
Ketentuan	5	16916,09	3383,218		
Total	10				

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In the fifth the energy content of the composition testing using a randomized design perfectly, with different results among the five treatments, testing is done to prove the level of significance of the difference of each fish feed. The hypothesis of this study is:

H_0 : There is no difference between theenergy content of the fifth mixture of fishfeed.

H_1 : There is a difference between the energy content of the fifth mixture of fish feed.

Furthermore, the calculation of the sum of squared error of observation to the sum of the squares on the experiment results. The results of the calculation are presented in Table 7.

The Central Square (KT) on each resource variance according to the respective freedom of degrees (df). The results of further calculations used to determine the amount of the value of F count is 1,350, which is presented in Table 8

The resulting F count was smaller than the value of F table; thus, H_0 was accepted and H_1 was rejected. No significant differences were observed between the energy content of the fifth mixture of fish feed better use of fishmeal and snail flour. These results can be used as a reference that the quality of fish feed ingredients pure fishmeal or snail flour mixture has the same energy content. Viewed from an aspect of the above test showed that no significant difference in the content of protein and energy produced in fishmeal and snail mixing flour. Both a chemical test to analyze thequality of forage fish. Based on the test chemical on the test fee showed that the substitution of fishmeal to snail flour with different levels of quality products the same feed. Result of the proximate analysis indicates the nutrient content of forage feed is in the range of test needs of fish. Therefore, snail flour can be used to completely replace fishmeal with fish fodder.

Conclusion

In an effort to increase the sustainability and decrease costs of milkfish farming, this work analyzed the effect of replacing fishmeal with snail flour in milkfish fodder. The following conclusions were drawn:

1. No significant difference in nutritional value was observed by replacing fishmeal with snail flour. Thus, snail flour can fully replace fishmeal in milkfish fodder.
2. No significant difference in DE was observed by replacing snail flour with fishmeal. Calculation of chemical test value shows that the DE in combination fishmeal and snail flour is similar.
3. Similarly, no significant differences in the protein content were observed between the milkfish fodder using fishmeal and thatusing snail flour.

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