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Process Capability Analysis for Quality Control at the Mixing Stage of Animal Feed Products at PT. Gold Coin Indonesia

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ABSTRACT

PT. Gold Coin Indonesia is one of the companies engaged in the processing of poultry feed, namely chicken, duck, quail, pig feed and fish feed. The products produced by this company consist of several types including crumble, layer, pellet and concentrate. The main problem discussed in this study is that there are still 201 C animal feed products (broiler starter) produced that do not meet the quality standard specifications set by the company, so concrete steps need to be taken so that the resulting quality can be achieved. The step taken is the process capability technique to see how far the process capability in producing the product is in accordance with the desired specifications. The data used in this study were the percentage of protein content, fat content, water content, ash content, calcium content and phosphorus content of animal feed products 201 C (broiler starter) to determine process capability by looking at the Cp and Cpk values. Based on the results of research conducted using process control techniques with control charts obtained control limits for each characteristic and the presence of data outside the control limits caused by general and special variations. Process Capability (Cp) has a value of less than 1 (Cp < 1) which means that the process is not good enough to meet the specifications so that its performance needs to be improved through improving the process itself. For water content (Cpk = 1.7202), ash content (Cpk = 3.3806), fat content (Cpk = 1.210) the Kane Performance Index (Cpk) > 1 and for protein content (Cpk = 0.5013), the levels of calcium (Cpk=0.998) and phosphorus content (Cpk=0, that the process is not good in meeting the specifications that have been set.

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1. INTRODUCTION

In today's development, many companies in Indonesia are developing, so that every company must be able to compete with other companies (Widyarto, 2013). Technological advances that are developing so rapidly make companies willing or unwilling to be able to adapt to any changes that exist if they want to remain competitive and survive (Indrajit, 2000). This encourages the company to further improve the quality of the products produced in accordance with the standards that have been set (Didiharyono, 2018). Products resulting from the production process do not always produce uniform product quality, either in one process or in a series of processes (Al Choir, 2020). The diversity of product quality can be determined by determining the quality characteristics

requirements (Ghanimata & Kamal, 2012). So that the requirements for quality characteristics that have been set become parameters in making decisions. For this reason, it is necessary to carry out quality control efforts (Budilaksono Et Al., 2010). Quality control is the process of controlling a product whether it is in accordance with the standards set by the company or not (Ratnadi & Suprianto, 2020). Quality control is one of the efforts to find the causal factors that cause substandard functions in the production process (Balol, n.d.). In controlling the process we try to quickly investigate if there is a process disruption and corrective action can be taken immediately before too many units are not suitable for production (Haryono, 2017).

In the case study of PT. Gold Coin Indonesia, products that customers expect according to the specifications set by the company are still outside the specification limits (Sav, 2018). This is due to the non-uniform level of nutritional needs for animal feed (Ramadhan et al., 2013). Where the specifications for the raw material requirements needed at PT. Gold Coin Indonesia include corn (40-50%), soybean meal (18-38%), bran (10-20%), fish flour (4-11%) ,grit(2-5%). From the results of field observations, it is shown that some of the sorted corn still contains water content > 16% (Damayanti et al., 2021). This is influenced by weather and climate conditions that cause the corn to become moist and moldy (Sundari, 2016). The fish meal used is not fish meal from mackerel, but imported fish meal from tuna so that the meat smells fishy. Apart from raw materials (Mangisah & Sumarsih, 2019), factor deviations also occur in humans, work methods, work environment and the facilities of the machines used in the production process (Auliya, 2017).

From the formulation of the problems that have been identified previously, the research objectives to be achieved are: 1. Create a statistical control model for process control in improving the quality of the process using the Average (X) and Distance (R) control map at PT. Gold Coin Indonesia. 2. Manipulate the model that has been formed to make recommendations about the actions that need to be taken to solve the problem. From the research conducted, it is hoped that it can provide input to various parties consisting of: (1) Benefits for students. The benefits for students are training students in conducting research in companies or factories and providing students with experience in applying statistical quality control methods in companies and factories. (2) Benefits for the Company. The benefits that can be obtained by the company are referrals or input for companies that can be used in controlling the quality of processes in the company (3) Benefits for Educational Institutions or Institutions Benefits for educational institutions or institutions, namely as a reference for further researchers related to statistical quality control at the same time will come.

2. RESEARCH METHOD

2.1 Data Collection

In practice, this research will require data to be processed. The data is divided into (1) Primary Data (Winerungan, 2013). Primary data was obtained by observing to get the percentage of protein content, fat content, water content, ash content, calcium content and phosphorus content in the production department, especially at the 201C animal feed product mixing station (broiler starter) (Astuti, 2012). The sampling was carried out three times per day which was assumed to represent all 201C animal feed products (broiler starter). (2) Secondary Data (Febrianto, 2019). Secondary data is obtained based on company records related to the required data (Sinain, 2013). The data is the quality standard specification data on the test variables based on the company's provisions (Zakaria & Suwitho, 2017).

2.2 Data Processing

The data that has been collected is then processed so that it can be used in research. Block diagram of data processing can be analyzed in Figure 4.2

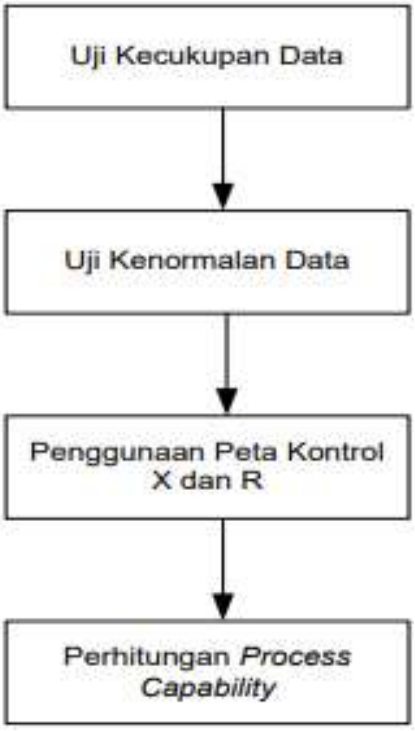

Figure 1. Block Diagram of Data Processing

2.2.1 Data Sufficiency Test

The data adequacy test was carried out to see whether the data used in the study were sufficient or not. In this data adequacy test, the following formula is used.

$$N' = \left[\frac{k/s\sqrt{N\sum Xi^2 - \left(\sum Xi\right)^2}}{\sum Xi} \right]^2 \quad (1)$$

Information :
k : index price whose value depends on the level of confidence
s : degree of accuracy
x : observation data
With 95% confidence level and 5% accuracy level, the formula used is as follows:

$$N' = \left[\frac{40\sqrt{N\sum Xi^2 - \left(\sum Xi\right)^2}}{\sum Xi} \right]^2 \quad (2)$$

In order for the research data to be sufficient, the value of N' must be smaller than the value of N

2.2.2 Data Normality Test

Test the normality of the data with the chi square test approach to determine whether the data comes from a normally distributed population or not. In the normality test of this data, the calculated value of x . is calculated
2 and compare it to the value of x
2 . When countx
2 < from tablex
2 , it can be concluded that the sample data is normally distributed.

2.2.3 Use of X and R . Control Map

By using X and R control maps to determine the characteristics of the distribution of the data studied.

2.2.4 Process Capability Calculation

This is done by determining the Cp and Cpk values of the process under study. The Cp value indicates whether the process carried out in the manufacture of a product is capable or not. While the Cpk value indicates whether the process carried out in the manufacture of a product has met the USL or LSL of the specifications set by the company.

2.2.5 Troubleshooting Analysis

In this section, an analysis of the quality performance of the processes contained in the production process will be examined based on the results of data collection and processing that has been done previously. The analysis carried out includes: 1. Process quality performance analysis, which aims to determine the tendency of quality performance and process stability from time to time during the period of time analyzed. 2. Analysis of the causal diagram, aims to identify the factors that cause the emergence of variation deviations. 3. Development of corrective or countermeasures necessary to control the performance of the analyzed process.

3 RESULTS AND DISCUSSIONS

3.1 Data Sufficiency Test

3.1.1 Protein Level Data

Protein content data was taken for one month by taking three samples and calculating the data adequacy test that required the values of X and 2 X can be seen in Table 5.8

Table 1. Protein Content Data and Calculations X and 2 X (Continued

Sampel	Tanggal	Pengukuran			$\bar{X}$	$\bar{X}^2$
		X1	X2	X3		
19	30-Des-08	21,23	21,77	21,59	21,53	463,5409
20	31-Des-08	21,59	21,4	21,46	21,4833	461,5336
Jumlah					**429,207**	**9211,678**

From the above calculation, the value of N' < N is 0.1295 < 20, so the amount of observation data is sufficient.

3.1.2 Fat Data

Data on the percentage of fat content was taken for one month by taking three samples and calculating the data adequacy test that required the values of X and 2 X can be seen in Table 5.9.

Table 2. Fat Content Data and Calculations X and 2 X

Sampel	Tanggal	Pengukuran			$\bar{X}$	$\bar{X}^2$
		X1	X2	X3		
1	1-Des-08	7,03	6,96	7,22	7,07	49,985
2	2-Des-08	6,44	6,98	6,93	6,783333	46,014
3	3-Des-08	6,95	7,02	6,84	6,936667	48,117
4	4-Des-08	7,03	6,87	6,8	6,9	47,61
5	5-Des-08	7,11	7,25	6,08	6,813333	46,422
6	9-Des-08	6,36	6,39	7,05	6,6	43,56
7	10-Des-08	6,47	6,16	6,77	6,466667	41,818
8	11-Des-08	6,62	7,5	7,07	7,063333	49,891
9	12-Des-08	6,46	6,69	6,73	6,626667	43,913
10	15-Des-08	6,63	6,64	6,31	6,526667	42,597
11	16-Des-08	6,64	6,47	6,64	6,583333	43,34
12	17-Des-08	6,93	6,78	6,71	6,806667	46,331
13	18-Des-08	7,07	7,23	7,17	7,156667	51,218
14	19-Des-08	7,55	7,12	7,16	7,276667	52,95
15	22-Des-08	7,69	7,54	7,39	7,54	56,8516
16	23-Des-08	6,96	6,86	6,92	6,913333	47,794
17	24-Des-08	7,13	7,53	7,41	7,356667	54,121
18	26-Des-08	7,21	7,14	7,39	7,246667	52,514
19	30-Des-08	6,89	7,51	7,5	7,3	53,29
20	31-Des-08	7,01	7,12	7,14	7,09	50,268
Jumlah					**139,03**	**968,152**

From the above calculation, the value of N' < N is 2,789 < 20, so the amount of observation data is sufficient.

3.1.3 Moisture Content

The water content data was taken for one month by taking three samples and the calculation of the data adequacy test requiring the values of X and 2 X can be seen in Table 5.10.

Table 3. Water Content Data and Calculations X and 2 X

Sampel	Tanggal	Pengukuran			$\bar{X}$	$\bar{X}^2$
		X1	X2	X3		
1	1-Des-08	5,78	6,19	5,82	5,93	35,1649
2	2-Des-08	6,14	6,24	5,88	6,0867	37,0475
3	3-Des-08	5,74	5,63	6,23	5,8667	34,4178
4	4-Des-08	5,41	5,88	6,06	5,7833	33,4469
5	5-Des-08	5,33	5,97	5,71	5,67	32,1489

Table 4. Water Content Data and Calculations X and 2 X

Sampel	Tanggal	Pengukuran (l)			$\bar{X}$	$\bar{X}^2$
		X1	X2	X3		
6	9-Des-08	5,75	5,62	5,7	5,69	32,3761
7	10-Des-08	6,18	5,43	5,73	5,78	33,4084
8	11-Des-08	6,01	6,14	5,99	6,0467	36,5622
9	12-Des-08	6,01	5,86	5,51	5,7933	33,5627
10	15-Des-08	5,36	5,73	5,53	5,54	30,6916
11	16-Des-08	5,72	6,48	5,44	5,88	34,5744
12	17-Des-08	6,08	5,33	6,33	5,9133	34,9675
13	18-Des-08	5,7	5,75	5,5	5,65	31,9225
14	19-Des-08	6,18	5,63	5,78	5,8633	34,3787
15	22-Des-08	6,03	6,35	5,97	6,1167	37,4136
16	23-Des-08	6,36	6,23	6,42	6,3367	40,1533
17	24-Des-08	6,23	6,33	6,26	6,2733	39,3547
18	26-Des-08	5,87	6,5	5,82	6,0633	36,764
19	30-Des-08	6,01	6,19	6,35	6,1833	38,2336
20	31-Des-08	6,12	6,29	5,97	6,1267	37,536
Jumlah					**118,59**	**704,125**

3.1.4 Ash Content Data

Ash content data was taken for one month by taking three samples and calculating the data adequacy test that required the values of X and 2 X can be seen in Table 5.11.

Table 5. Ash Content Data and Calculation of X and 2 – X

Sampel	Tanggal	Pengukuran			$\bar{X}$	$\bar{X}^2$
		X1	X2	X3		
1	1-Des-08	11,74	11,67	10,91	11,44	130,8736
2	2-Des-08	11,75	11,39	11,12	11,42	130,4164
3	3-Des-08	11,37	11,08	11,48	11,31	127,9161
4	4-Des-08	11,18	10,99	11,88	11,35	128,8225
5	5-Des-08	10,9	11,43	12,13	11,4867	131,9435
6	9-Des-08	11,17	11,06	10,96	11,0633	122,3973
7	10-Des-08	11,49	11,39	11,73	11,5367	133,0947
8	11-Des-08	12,05	11,46	10,93	11,48	131,7904
9	12-Des-08	11,44	11,25	12,12	11,6033	134,6373
10	15-Des-08	11,15	11,18	11,83	11,3867	129,6562
11	16-Des-08	11,76	11,95	11,6	11,77	138,5329

Table 6. Ash Content Data and Calculation of X and 2 X (Continued)

Sampel	Tanggal	Pengukuran			$\bar{X}$	$\bar{X}^2$
		X1	X2	X3		
12	17-Des-08	11,34	11,23	11,64	11,4033	130,036
13	18-Des-08	12,21	11,48	11,48	11,7233	137,4365
14	19-Des-08	11,67	11,45	10,91	11,3433	128,6712
15	22-Des-08	11,59	12,1	10,87	11,52	132,7104
16	23-Des-08	11,64	12	11,16	11,6	134,56
17	24-Des-08	11,45	10,91	11,67	11,3433	128,6712
18	26-Des-08	11,44	11,22	11,8	11,4867	131,9435
19	30-Des-08	11,01	11,47	11,27	11,25	126,5625
20	31-Des-08	11,46	12,17	11,63	11,7533	138,1408
Jumlah					**229,27**	**2628,813**

From the above calculation, the value of N' < N is 0.350 < 20, so the amount of observational data is sufficient.

3.1.5 Calcium Level Data

Data on calcium levels was taken for one month by taking three samples and calculating the data adequacy test that required the values of X and 2 X can be seen in Table 5.12.

Table 7. Calcium Level Data and Calculation of X and 2 X

Sampel	Tanggal	Pengukuran			$\bar{X}$	$\bar{X}^2$
		X1	X2	X3		
1	1-Des-08	0,96	0,97	0,92	0,95	0,9025
2	2-Des-08	0,93	0,93	0,82	0,89333	0,798
3	3-Des-08	0,92	0,91	0,96	0,93	0,8649
4	4-Des-08	0,92	1,1	1,1	1,04	1,0816
5	5-Des-08	1,09	1,1	1,02	1,07	1,1449
6	9-Des-08	1,1	1,06	0,89	1,01667	1,0336
7	10-Des-08	1,02	0,93	1,04	0,99667	0,9933
8	11-Des-08	1,02	1,02	0,88	0,97333	0,9474
9	12-Des-08	1,06	1,09	1,07	1,07333	1,152
10	15-Des-08	1,01	0,9	1,03	0,98	0,9604
11	16-Des-08	1,01	1,08	0,99	1,02667	1,054
12	17-Des-08	0,97	1,03	0,94	0,98	0,9604
13	18-Des-08	1	1,03	1,1	1,04333	1,0885
14	19-Des-08	0,96	1,06	1,06	1,02667	1,054
15	22-Des-08	1,05	1,05	1,09	1,06333	1,1307
16	23-Des-08	1,03	0,99	1,02	1,01333	1,0268
17	24-Des-08	0,94	0,98	1,06	0,99333	0,9867

Table 8. Calcium Level Data and Calculation of X and 2 X (Continued

Sampel	Tanggal	Pengukuran			$\bar{X}$	$\bar{X}^2$
		X1	X2	X3		
18	26-Des-08	0,87	0,85	0,95	0,89	0,7921
19	30-Des-08	1,03	0,83	0,85	0,90333	0,816
20	31-Des-08	1,03	0,97	0,85	0,95	0,9025
Jumlah					**19,8133**	**19,691**

From the above calculation, the value of N' < N is 5.13 < 20, so the amount of observation data is sufficient.

4. CONCLUSION

From the results of the discussions that have been described in previous chapters, it can be concluded that: (1) Based on the analysis of the causal diagram, the main factors that cause variations in special causes at the mixing stage of animal feed products are 201 C (broiler starter) for the percentage of fat content is: - Raw materials. a. lack of one or raw material that is a component of animal feed at the material preparation stage (a stage in the production process to prepare all raw material needs to be processed). b. The quality of fish meal varies from local and imported. Where fish meal is used only on the bones, head and tail which causes low fat content. c. there is mixing of materials with other materials, the original smell of the material will fade, like real fish meal, the specific fishy smell will disappear when the ingredients are mixed. - Man. e. communication between supervisors and operators often does not go well. Supervisors do not provide information and knowledge about materials. Meanwhile, the operator's knowledge of materials science and appropriate methods can only be obtained from experience. f. in work do not pay attention to SOP. g. the quality control section is less thorough or less firm in maintaining the quality criteria that have been set so that bad goods can enter the warehouse. h. suppliers intentionally or unintentionally place low-quality raw materials in hard-to-reach stockpiles at the time of the first inspection. - Working Method : a. error in the production process in the factory where there is contamination between different raw materials due to imperfect handling in the warehouse. - Work Environment: a. too fast removal of the choice of bin at the intake section so that the fat raw material enters and mixes in the wrong bin so that it contaminates the raw material in the bin. b. rancidity of feed ingredients occurs because fatty acids at room temperature are overhauled due to hydrolysis or oxidation - Machinery :b. did not check in detail and periodically (2) Based on the results of the calculation of the control limit using the control chart, data were obtained that were outside the control limit, namely the percentage of fat content, while the levels of protein, water, ash, calcium and phosphorus were within the control limits. (3) Data revision can be done if abnormal variations are caused by special variations. While the general variation can only be corrected by the company's management. (4) Calculation of the percentage of process capability for each percentage of protein, fat, water, ash, calcium and phosphorus content is carried out after the process is under control. If there are still data outside the control limits, then revisions must be made by eliminating data that are outside the control limits to get a new control limit. (5) The percentage value of process capability for each percentage content is: - Protein content, Cp = 0.928 and Cpk = 0.5013. - Fat content, Cp value = 2.17390 and Cpk = 1.210 - Water content, Cp value = 2.102 and Cpk = 1.7202 - Ash content, Cp value = 3.465 and Cpk = 3.3806 - Calcium content, Cp value = 1 .05 and Cpk = 0.998 - Phosphorus content, Cp value = 0.980 and Cpk = 0.5558

Suggestions from this research are: (1) Improving work coordination, especially the Quality Control section so that there is no error in calculating the percentage of protein, fat, water, ash,

calcium and phosphorus levels when samples are taken in the laboratory. (2) Using the X-bar and R control charts to monitor the ongoing process from time to time, immediately corrective action is taken if there are any unwanted changes in the process. (3) Should further improve the quality by adding skills and knowledge to operators, especially in the quality control department in accordance with the SOP. (4) It is necessary to carry out proper testing while taking into account any causes that affect the control of the percentage of protein, fat, water, ash, calcium and phosphorus. (5) There is still low process capability, so companies need to carry out strict supervision of the performance of the production process in order to obtain the specifications desired by the company in meeting customer satisfaction. (6) The company must pay attention to and take concrete action on the causes that affect the quality of quality characteristics.

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