

TESTING OF DEVIATIONS OF PATE FILLING SYSTEM USING PARETO METHOD*

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Summary

The main goal of this research study was to find the causes of the deviation system for filling chicken pate in samples of different weights, with 27 g and 45 g. By applying the recognized methods of determining the level of process control for the calculation of the potential index (Cp) and the capacity index (Cpk) of the process, it was necessary to determine whether the filling process is under control.

The research was performed in the plant for the production of chicken pate, and the samples needed for the research were collected on the technological line for the production of chicken pate, at the process steps for filling and closing. Samples were taken from the filling line periodically at intervals of 30 minutes to 60 minutes. For each group, 500 measurements were performed over a period of several days depending on the production plan for a given group of samples.

The results of the research show that the examined filling processes in both groups meet the requirements on filling quantities prescribed by the Internal Regulations, as well as the EU Directive on prepacked products (76/211 / EEC, ANEX 1) and (75/106 / EEC). Calculations of process ability indicators indicated that according to the values of Cp and Cpk index (precision and adjustment), the process of filling 27 g of chicken pate belongs to the group of precise and adjusted process, while the process of filling 45 g of chicken pate belongs to the group of precise but unadjusted processes. CpU and CpL centering indicators indicate the non-centering of both processes, i.e. the measured values in both, group I and group II go towards the upper limit of the specifications. The results showed in the first process there is no defect at all, so there are no measured values outside the specifications, while in the second process the percentage of defects is 31.4%. Determining the causes of deviation using the Pareto method indicated the fact that overload dosing, lack of weight in the dosing can and damage to the packaging cause the largest number of defects (89.5%).

Key words: *filling system, chicken pate, Pareto method, potential index, capacity index*

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INTRODUCTION

The technological production process of chicken pate is a complex process consisting of a series of operations, the last step is filling or dosing the pate into packaging. Although there is an opinion, especially among manufacturers, that this step in the production of pate is less risky in terms of impact on the quality of the finished product than, for example, the preparation of raw materials or making the mass and here mistakes are possible (Burr, 1990). In the process step of filling, special attention should be paid to the compliance of the net quantity of the product with the nominal quantities, i.e. compliance with the requirements according to legal regulations (Rampersad, 2000; Novak and Vukasović, 2016).

The prepared pate is packed, hermetically sealed and heat-treated in the shortest possible time. This ensures sterility and durability, and the quality and microbiological correctness of the product. Much attention is paid to the packaging, which must be safe and preserve the quality and durability of the product. Dosage (weight control) as well as the other parameters in the filling process (speed, number of filling per hour, pressure, temperature, etc.) are automatically adjusted on the filler depending on the type of product (Rampersad, 2000). After the packaging is filled, the aluminum lid is automatically placed on the can, and under pressure and high temperature, the polyethylene mass of the lid and the can melt so that they stick together and create an impermeable layer, and it is hermetically sealed. The correctness of the closure (tightness) as well as the net weight of the product is checked every 30 minutes (Novak and Vukasović, 2016).

Control is not limited to the control of raw materials, semi-finished products and the finished product. It refers to the entire production process, so that the risk of food malfunction and other food quality indicators is reduced to a minimum (Harry and Schroeder, 2000). Production process control can be divided into two basic systems:

1. Off-line control system in which the control is performed outside the production line. Measurement samples can be taken at any time, and the results of the analyzes do not follow the course of the production process, but these results are obtained even after the completion of the production process.
2. The online control system provides current quality indicators. Critical factors are measured continuously during the process at given time intervals. Information is obtained during the process (Harry and Schroeder, 2000).

The ability of the process that creates quality is most often examined (measured, controlled), analyzed and evaluated using capability indicators such as: process potential or precision index C_p (process dissipation measure) and ability index - accuracy C_{pk} (process adjustment measure). The detection system detects non-compliant products after production, i.e. in the "after production" phase. The system was applied to control input components and control the finished product in order to discard or modify non-compliant products (Harry and Schroeder, 2000). Within the prevention system, the focus of quality management is shifting from the "after production" phase to the "on line" phase, ie to the production process itself. This

approach includes planning, control and quality assurance, as well as improving the quality of individual processes. Process capability is an industrial term that refers to the relationship between the "tolerance" of a product specification according to the bias and variation (standard deviation) of the process. The high "capability" process is more likely to produce products within the permitted specification, and conversely, the low "capability" process has a greater chance of obtaining defective products. The "ability" of the process is most often expressed through Cpk, which is calculated as $Cpk = \text{specification tolerance (deviation)} / 3 Sd$ (Ignjatović, 2004).

The assessment of the capabilities (possibilities) of the process is the assessment of the scattering and tuning of the process in the state of statistical control. When the data follow a normal distribution, the ability is defined by the term "scattering" of the process and measured by the natural tolerance $T_p = 6 \cdot \sigma$ where the scattering contains 99.73% of the matched products. Ability analysis is performed to answer the questions: "Should the process be improved?" And "If so, by how much?" The analysis of process capabilities aims to show which processes are not under normal conditions, where variations occur, and how much the obtained values deviate from the required quality measures (Karahmet *et al.*, 2021; Lazić, 2011).

The basic role of the Pareto method is to enable management to distinguish the essential from the irrelevant for the improvement of quality or the overall economy (Chase, 1993). Using this method, management obtains information on the relative contribution of each factor to the overall consequence (Perović and Krivokapić, 2007).

MATERIAL AND METHODS

The material for this study consisted of two groups of chicken pate samples: Group I - chicken pate filled in aluminum cans of 27.0 g, Group II - chicken pate filled in aluminum cans of 45.0 g. Samples were taken from the production line at the process step for filling and closing for a period of 10 days, or 100 samples per day. A total of 1,000 samples were collected, or 500 per each group.

The collected samples were weighed on an analytical balance, after which the weight of the empty packaging (dose + lid) was taken from the weighed mass in order to obtain the mass of the product. Weighing 50 samples of empty packaging, the mean value was obtained, which is:

- Group I - for packaging of 27 g - 2.1112 g and
- Group II - for packaging of 45 g - 2.5535 g.

The standard deviation in group I was 0.0200, and in group II 0.0145, which shows that the weight of the packaging is not standard, but also that the variations in weight are negligibly small. For group I, variations in the weight of packaging were from 2.0982-2.1130 g, while for group II they were from 2.5286-2.5760 g.

The obtained results were entered and processed in Excel. For statistical processing of data obtained by measurements, the software package (software) Excel SPC Software - QI Macros was used, which was used to calculate the potential index (Cp) and capability index (Cpk) of the process and other indicators of process capability (CpU,

CpL, Cpm, Pp, PPK, etc.). All measurements are presented using histograms also with the QI Macros software package.

RESULTS AND DISCUSSION

Determining the causes of deviations in the system of filling and closing the packaging and testing the ability of this phase of filling the pate is of great importance from the manufacturer's point of view to reduce waste, i.e. costs and improve the process by removing the causes of deviations. If the process is not controlled, adjusted and centered, there may be deviations in the weight of the finished products, which leads to unnecessary costs, deviations from legal regulations.

Group I - chicken pate filled into aluminum cans of 27 g.

The first group of samples was chicken pate weighing 27 g packed in aluminum packaging.

500 samples were taken from the line by random sampling and for each of the samples was calculated:

- net weight in g.,
- deviations from the nominal quantity in g.,
- deviations from the nominal quantity in percent.

After that, statistical data processing was performed, which is shown in Table 1. From the data presented in the table, it can be seen that for 500 tested samples of pate, the net weight varied from 27.02 to 28.00 g. The mean net weight of the pate was 27.49 g, which is relatively close to the nominal amount of filling (27.00 g). The allowed deviation from the nominal weight according to the Quality Specification of 27 g chicken pate is -0.5 g and +1.0 g. Therefore, the allowed variation of the weight of the pate of 27 g is in the range of 26.5-28.0 g. The mean deviation from the nominal filling quantity was only 0.49 g or 1.82%. These results indicate that the obtained values of mass, ie the mean value of the deviation in grams and the mean value of the deviation in percent meet the prescribed criteria.

Table 1. Results of statistical processing for I and II group of samples

Indicators	I group – 27 g	II group – 45 g
Number of samples	500	500
The total sum of the masses in g	13.746,73	22.693,31
Mean mass in g	27,49	45,39
Minimum value of mass in g	27,02	44,88
Maximum value of mass in g	28,00	46,00
Standard deviation	0,19	0,2016
Nominal quantity in g	27,00	45,00

Permitted deviation in g	from 26,5- 28,0 g	from 44,1 g to 45,5 g
Minimum value of deviation from nominal quantity in g	0,02	0,12
Maximum value of deviation from nominal quantity in g	1,00	1,00
Mean value of deviation from nominal quantity in g	0,49	0,39
Minimum value of deviation from nominal quantity in%	0,07	0,27
Maximum deviation value from nominal quantity in%	3,70	2,22
Mean deviation from nominal quantity in%	1,81	0,87

The obtained results show that the process, in addition to meeting the above regulations, has a low standard deviation (0.19), ie that the range between the minimum (27.02 g) and maximum (28.00 g) of the measured mass is small, it was 0,98 g. Such results indicate great precision and tuning of the controlled process. Calculations of the process potential index (Cp), process capability index (Cpk), and other process capability indicators are presented graphically using histograms (Figure 1).

Based on the data shown in the histogram, it can be seen that the scattering of the process ($\pm 3\sigma$) is within the limits of specifications (lower tolerance limits / LSL - 26.50 and upper tolerance limits / USL - 28.00), which is the first sign that the process is capable. Based on the values of process capability indicators in a longer time interval, process potential index (precision) $Cp = 2.52 > 1.33$ and capability index (accuracy, setting) $Cpk = 1.70 > 1.33$, which have relatively high values, it can be concluded that the process of filling pate weighing 27 g belongs to the group of precise and accurate (adjusted) processes.

The ability ratio $Cr = 0.40$ confirms that the process is capable (for a capable process the Cr index should be less than 1).

The values of $CpL = 3.34$ and $CpU = 1.70$ are not equal, which indicates the non-centering of the process, which can be seen from the presented histogram. Namely, the values tend towards the upper limit of tolerance (USL). With ideal centering of the process, the values of CpL and CpU should be equal.

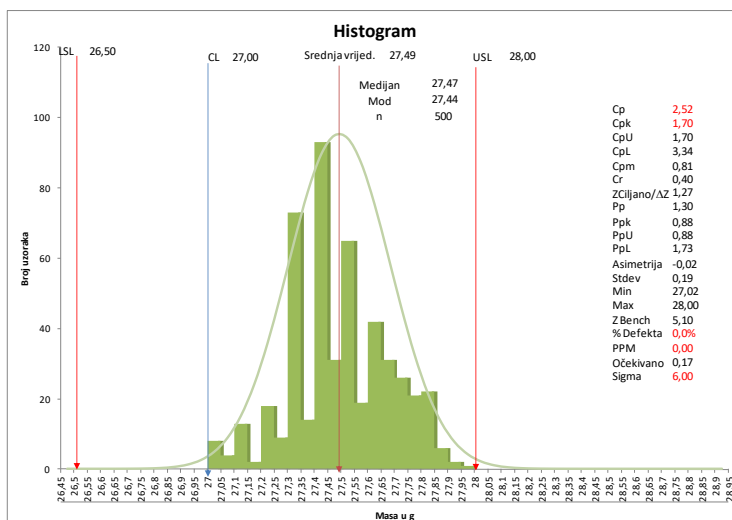


Figure 1. Histogram for group I samples - 27 g pate

Preliminary assessment of process capability is conducted at the beginning of the process or after a relatively short process monitoring time. The capable process should have Pp and Ppk values ≥ 1.67 . Since the obtained indicators (Pp = 1.30 and Ppk = 0.88) are less than 1.67, there is a danger that an anomaly will occur in a large number of samples, which will bring the process to the limit of ability.

The indicator of process capability in a short time interval is $Z_{\text{targeted}} / \Delta Z$. It shows how far the mean deviates from the target value, and it is recommended that it be less than 0.5. $Z_{\text{targeted}} / \Delta Z$ for the pate filling process weighing 27 g was 1.27.

The obtained percentage of defect is 0.0%, which shows that all measured values of net weight of finished products are within the limits of the specification (LSL and USL). This indicator is also in line with the PPM (number of errors per million possibilities) and sigma level. Calculations of the process capability indicated that the process works at the 6-sigma level, which is confirmed by the obtained results, primarily PPM and % of defects, as well as the values of Cp, Cpk and others. It can be concluded that the obtained results of process capability indicators are extremely good and rank the examined process at the highest level of capability.

Group II - chicken pate filled in aluminum cans of 45 g

The second group of samples consists of chicken pate with a net weight of 45 g, filled in aluminum cans. For the research, 500 samples were taken at random from the production line and for each of the samples the net weight in g, deviations from the nominal quantity in g., and deviations from the nominal quantity in percent were calculated.

From the data given in the table 1 it can be seen that for 500 tested samples of pate of the second group the net weight varied from 44.88 to 46.00 g. The mean value of the net weight of the pate was 45.39 g., which is relatively close to the nominal amount of

filling (45.00 g.). The permissible deviation from the nominal weight according to the Quality Specification of 45 g of chicken pate is -0.9 g. and +0.5 g. Therefore, the allowed variation of the weight of the pate of 45 g. is in the range of 44.1 to 45.5 g. The mean value of deviation from the nominal amount of filling was only 0.39 g. or expressed as a percentage of 0.87. These results indicate that the obtained values of mass, i.e. the mean value of the total deviation meet the criteria.

The obtained results show that the process, in addition to meeting the above regulations, has a low standard deviation (0,2016), i.e. that the range between the minimum (44.88 g.), and maximum (46.00 g.) of the measured mass is small and amounts to 1,12 g. These results indicate, as in the first group of samples, the high precision and adjustment of the tested process.

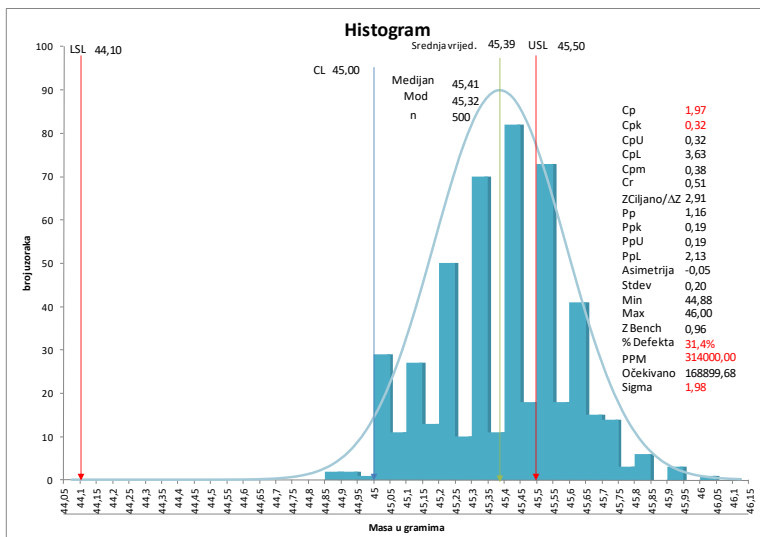


Figure 2. Histogram for group II samples - 45 g pate

Based on the data shown in the histogram, it can be concluded that the scattering of the process ($\pm 3\sigma$) is within the limits of specifications (lower tolerance limits / LSL - 44.10, and upper tolerance limits / USL - 45.50), which is the first sign that the process is capable. Based on the values of process capability indicators in a longer time interval, process potential index (precision) $Cp = 1.97 > 1.33$, and capability index (accuracy, setting) $Cpk = 0.32 > 1.33$, which have relatively high values, it can be concluded that the process of filling pate weighing 45 g. belongs to the group of precise but not accurate (adjusted) processes.

The ability ratio $Cr = 0.51$ confirms that the process is capable (for a capable process the Cr index should be less than 1).

The values of $CpL = 3.63$ and $CpU = 0.32$ are not equal, which indicates a small lack of centering of the process, which can be seen from the presented histogram. Namely, the values tend towards the upper limit of tolerance (USL). With ideal centering of the process, the values of CpL and CpU should be equal.

Process performance indicators P_p and $P_{pk} \geq 1.67$ indicate the ability of the process to meet consumer needs. Preliminary assessment of process capability is conducted at the beginning of the process or after a relatively short process monitoring time. The obtained values ($P_p = 1.16$ and $P_{pk} = 0.19$) are lower than 1.67 which means that the process is shifted towards the ability limit.

The process ability indicator in the short time interval $Z_{targeted} / \Delta Z$ (recommended to be less than 0.5), for the process of filling pate weighing 45 g. was 2.91.

The obtained percentage of defects is 31.4%, which shows that all measured values of net weight of finished products are within the limits of the specification (LSL and USL). This indicator is in line with both the PPM (number of errors per million possibilities) and the sigma level. Calculations of the process capability indicated that the process works at the 1.98 sigma level, which is confirmed by the obtained results, primarily PPM, and % of defects and the values of C_p , C_{pk} and others. It can be concluded that the obtained results of process capability indicators are extremely good, and rank the examined process at the highest level of capability.

The results of calculations for both groups of samples show high values of indicators process capability, especially C_p and C_{pk} (indices of precision and setting), which examined the processes classified as extremely precise and set processes. This can be explained by a small deviation of the net weight of pate samples (mean deviation for group I samples - 0.49 g. or 1.83%, and 0.39 g. or 0.86% for group II) in relation to the legally prescribed tolerances of the nominal quantity. That is why the tested processes have high values of process capability indicators, no defects, PPM is zero, and work at the 6-sigma level.

Determining the causes of deviations in the charging system of the examined groups of samples. The causes of deviations were determined during the sampling period, when problems that occurred during production at the process step for filling and closing were monitored and recorded. Table two lists the possible causes of deviations in the process step for filling and closing, on which the net weight of the finished products depends, i.e. the level of accuracy of the filling system.

The causes of deviations were determined during the sampling period, when problems that occurred during production at the process step for filling and closing were monitored and recorded. Table two lists the possible causes of deviations in the process step for filling and closing, on which the net weight of the finished products and the level of accuracy of the filling system depend.

Table 2. Causes of deviations in filling systems

Type of cause	Corrective measures
Dosing overload, due to high filling and closing speed	Correction of machine parameters - loading speed.
Lack of mass in the dosing bowl	Expert inspection of the machine and probe for repair and training for continuous operation. If necessary, replace the faulty probe in the filler hopper.
Damage to the can or lid	A corrective measure may be a visual inspection of the cans and lids before placing them on the filling line.
Closing dose at closing	Mass filling pressure correction. If necessary, temper the filling mass.
Heater temperature during gluing	Heater temperature control when gluing the cover. Visual inspection of welds.
Calibration	Regular calibration
Human error	Strengthen supervision and training of employees

In samples of group I, results showed no defects (values outside the specification limits). The standard deviation between the measured values is only 0.19, which is exceptional for the examined process. However, there is a very pronounced lack of centering of the process, i.e. the tendency of the measured values towards the upper limit of the specifications (this is indicated by CpU and CpL).

Overloading due to the high rate of filling and closing in the tested process can cause problems that do not manifest themselves by creating defects that affect the setting and centering of the process that are slightly worse than other indicators of process capability.

In samples of group II results showed that there is a deviation, and the resulting defect is 31.4% (values outside the specifications).

In group II of samples, the main cause of deviations is overload dosing (high filling speed), which is explained by the large amount of daily production (over 60 thousand pieces), and the need for faster filling. The following figure graphically presents the listed causes of deviations and ranks them according to significance (areas A, B and C) based on the Pareto principle.

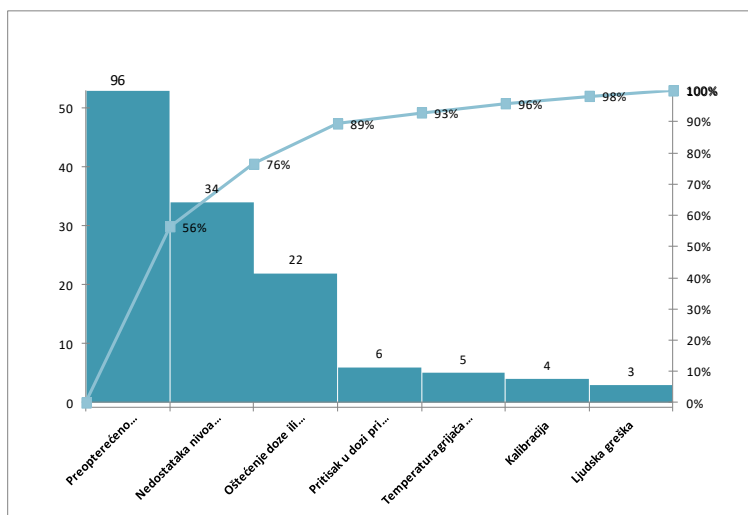


Figure 3. Pareto for second group of samples

Determining the causes of deviations in these two groups of samples (chicken pate filled in packages of 27 and 45 g), showed that in both groups there is a small deviation between the measured values (net weight of finished products). This indicates that the process is very precise and moderately adjusted, especially for the group of samples of 45 grams, which is indicated by the calculations of the process performance indicators. Within the first group of samples (27 grams) the process has no defects at all while in the second group (45 grams) there is a significant number of errors that can be reduced by interpreting Pareto diagrams by eliminating the cause of errors in area A in this process. The reason for the appearance of errors is the high specifications in relation to the variations in the charging process. However, the process capability indicators very much point to the fact that the process can be centered and undoubtedly one of the main reasons for the high process capability is the filling machine and the setting to shut down automatically when a defect occurs.

DISCUSSION

The results of the measurement of the net weight of the finished products show that the processes of filling chicken pates of 27 g., and 45 g. meet the Internal Regulations in Company Ltd. (specification of quality chicken pate 27 g., and 45 g., no. 7040 and 7041). Namely, in both groups of samples the measurements showed that the mean values of deviations from the nominal mass in grams (0.49 in group I and 0.39 in group II), and the mean values of deviations from the nominal mass in percent (1.83% in group I) and 0.86% for group II) meet the deviations prescribed by the above internal regulations, according to which deviations in grams and percentages are allowed for net quantities of 27 g., and 45 g. as follows:

- for packages of 27 g.: -0.5 and +1.0 g., or 1.85% for negative and 3.70% for positive deviation;
- for packages of 45 g.: -0.9 and +0.5 g., or 2% for negative and 1.11% for positive deviation.

The results of the calculation of the standard deviation show that the value in both groups is low (0.19 in group I and 0.20 in group II), which indicates small ranges between the measured values. Such data indicate the high precision of the examined process. Oslić [11] states that sigma (in statistics, standard deviation) is a measure of process dissipation or a measure of quality. Therefore, the obtained sigma values initiate a small scattering of the examined processes.

According to the results for the potential index (precision) C_p , and the ability index (setting) C_{pk} , obtained in this paper, the examined processes are classified into the following groups:

- the process of filling pate in aluminum cans of 27 g. belongs to the group of precise and adjusted processes. The C_p value is 2.52 and the C_{pk} value is 1.70.
- The process of filling pate in aluminum cans of 45 g. belongs to the group of precise but not adjusted processes. The values of the C_p and C_{pk} indices are 1.97 and 0.32, respectively.

As can be seen from the obtained results, both groups have acceptable values of the C_p index, so in both groups there is a small scatter between the measured values, ie the processes are precise. Regarding the adjustment index (C_{pk}) in group II there is a much higher unadjustment of the process, which is indicated by the value of C_{pk} (0.32).

By comparing the values of the C_{pU} and C_{pL} indices, the position of the process can be determined (Runje, 2003).

- identical amounts indicate complete centering of the process (the value of the index C_{pk} is equal to the value of the index C_p),
- an amount less than 1 indicates the occurrence of a mismatch and
- The process has moved towards the specification limit of the smaller index amount.

According to calculations performed on the basis of the Pareto method, the three main causes of deviations in the tested processes are overload dosing due to high filling and closing speed, lack of mass levels in the dosing vessel and damage to the dose or lid, which cause as much as 89% of problems in the 45 g pate filling process. Kilibarda (2008) points out that there are three areas according to the degree of significance of the given causes for the problem analyzed by the Pareto diagram. The stated causes that belong to area A represent the area of the largest increase in the observed quantities (Donevski, 2011). This is actually an area with a group of causes that most influence the occurrence of the analyzed problem and it is a group of causes that, according to the theory of the Pareto method, should be addressed as a priority.

Overloaded dosing (high filling speed) was singled out as the main cause of deviations, which is explained by the large amount of daily production (over 60 thousand pieces), and the need for faster filling. It is estimated that removing 20% of the causes can solve 80% of the problems (Burr, 1990). Therefore, special attention should be paid by the management and those responsible for quality to solving or eliminating the stated

causes of deviations, which would eliminate 89% of the problems, with the aim of improving the examined processes.

Determining the causes of deviations showed that the same causes occur in both processes. However, the second process is the one in which the percentage of defects is 31.4% and in which these causes occur in a much higher intensity compared to the first process. The reason for this is primarily a slightly higher tolerance of tolerances when filling pate of 27 g, where a positive deviation is allowed (since deviations occur in both processes in the positive direction) 3.70% in contrast to the process of filling pies of 45 g, a positive deviation of 1.11% is allowed.

According to the European Community directive in which a deviation of (negative) 9% is allowed, the examined processes work at six sigma level and other indicators of process capability have extremely high values, which means that processes according to this standard are extremely adjusted, precise and under control.

CONCLUSIONS

During this research work, it was confirmed that the tested filling processes in both groups meet the requirements for nominal filling quantities prescribed by the Internal Regulations, as well as by the EU Directive on prepackaged products (76/211/EEC, APPENDIX 1) and (75) /106 / EEC). The checked weights of the samples showed that the packaging is not of standard weight, and that the weight of the packaging is not constant, there are deviations, but they are still minimal and insignificant. Values of process ability C_p and C_{pk} index (accuracy and adjustment) the process of filling 27 g. of chicken pate belongs to the group of precise and adjusted processes, while the process of filling 45 g. of chicken pate belongs to the group of precise but unadjusted processes. Centering indicators C_{pU} and C_{pL} indicate non-centering of both processes, that is, the measured values in both group I and group II tend to the upper limit of the specification. In this case, consumers receive slightly more product than declared, but do not exceed the upper limit of the specification. The research determined the causes of deviations which are insignificant in the filling of pate of 27 g., while in the filling of 45 g., they occur much more intensively and cause 31.4% of defects. Determining the causes of deviations using the Pareto method indicated the fact that three groups of causes (dosing overload, lack of weight in the dosing container and packaging damage) cause the largest number of defects (89.5%). Analysis of determining the causes of deviations in the filling system of the tested samples indicates the need to solve the problem in the 45 g. pate filling system by eliminating primarily the causes in area A, which are three groups of causes on the Pareto diagram, which would eliminate 89.5% of failures. For this purpose, it is necessary to give recommendations for the improvement of the tested processes, first of all their placement, centering, and in general to bring the systems under a higher level of control. In this way, a balance between the processes would be achieved and the causes of deviations in the examined processes would be eliminated or reduced to an acceptable level.

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TESTIRANJE ODSUPANJA SISTEMA PUNJENJA PAŠTETE PARETO METODOM

Osnovni cilj ovog istraživanja bio je pronaći uzroke odstupanja sistema punjenja pileće paštete u uzorcima različite težine, od 27 g i 45 g. Primjenom priznatih metoda određivanja nivoa kontrole procesa za proračun indeksa potencijala (C_p) i indeksa kapaciteta (C_{pk}) procesa bilo je potrebno utvrditi da li je proces punjenja pod kontrolom.

Istraživanje je obavljeno u pogonu za proizvodnju pilećih pašteta, a uzorci potrebni za istraživanje prikupljeni su na tehnološkoj liniji za proizvodnju pašteta u procesnim fazama punjenja i zatvaranja. Uzorci su uzimani sa linije za punjenje periodično u intervalima od 30 minuta do 60 minuta. Za svaku grupu izvršeno je 500 mjerenja u periodu od nekoliko dana u zavisnosti od plana proizvodnje za datu grupu uzoraka.

Rezultati istraživanja pokazuju da ispitivani procesi punjenja u obje grupe ispunjavaju zahtjeve o količinama punjenja propisane Internim pravilnikom, kao i Direktivom EU o prethodno upakovanim proizvodima (76/211/EEC, PRILOG 1) i (75/106). / EEZ). Proračuni pokazatelja procesne sposobnosti pokazali su da prema vrijednostima C_p i C_{pk} indeksa (preciznost i podešavanje) proces punjenja 27 g pileće paštete spada u grupu preciznih i prilagođenih procesa, dok proces punjenja 45 g pileće paštete spada u grupu preciznih i prilagođenih procesa. spada u grupu preciznih, ali neprilagođenih procesa. C_{pU} i C_{pL} indikatori centriranja ukazuju na necentriranje oba procesa, tj. izmjerene vrijednosti u grupi I i grupi II idu prema gornjoj granici specifikacije. Rezultati su pokazali da u prvom procesu nema nikakvog defekta, tako da nema izmjerenih vrijednosti van specifikacija, dok je u drugom procesu postotak grešaka 31,4%. Utvrđivanje uzroka odstupanja Pareto metodom ukazalo je na činjenicu da preopterećenje doziranja, nedostatak težine u doziranju i oštećenje ambalaže uzrokuju najveći broj nedostataka (89,5%).

Ključne riječi: *sistem punjenja, pileća pašteta, Pareto metoda, index potencijala, index kapaciteta*