ARTIGO 233

EVALUATION OF THE PROCESS, PRODUCTS AND INSTALLATIONS OF A FEED MILL: A STUDY OF CASE

Avaliação dos processos, produtos e instalações de uma fábrica de ração: um estudo de caso

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ABSTRACT: observing the requirements and seeing the importance of the aspects involving safety and feed quality, the objective of this work was to evaluate the quality of the process, products and installation used in a feed mill, with production capacity of 1,000 ton.day^{-1}, located in Minas Gerais State, Brazil. The evaluation was based on questionnaires application, giving up notes and concepts according to implementation levels of the ISO 9000:2000 and the Good Manufacturing Practices Manual (GMP). Among the process, the systems of receiving and storage of raw materials, the production and expedition process of the feed were evaluated, as well as the management, control quality, supply water, refectory, and equipment maintenance sectors. In addition, the physical structure of the feed mill compose by windows, walls, doors, floors, roofs, illumination, ventilation, protection system and access were evaluated. Furthermore, the control quality system of the microingredients, macroingredients and final products were analyzed. The results showed that the diet assessment in the mill did not provide a suitable control system for production of high feed quality. The quality management system used in accordance to ISO 9000:2000 not found full requirements according to the standard. The Good Manufacturing Practices (GMP) was not implemented in full for most of the sectors. In conclusion, all assessed sectors had specific problems of installation or control system that compromise the final product quality.

Key-words: processing, quality, safety

RESUMO: observando os requerimentos e vendo a importância dos aspectos envolvendo a segurança e a qualidade das rações, objetivou-se com esse trabalho avaliar a qualidade dos processos, produtos e instalações usadas em uma fábrica de ração, com capacidade de produção de 1000 ton.dia^{-1}, localizada em Minas Gerais, Brasil. A avaliação foi baseada em aplicações de questionários, atribuindo-se notas e conceitos conforme o nível de implementação, de acordo com as normas ISO 9000:2000 e do Manual das Boas Práticas de Fabricação (BPF). Entre os processos, foram avaliados os sistemas de recebimento e armazenamento de matérias-primas, os processos de produção e expedição das rações, os setores de administração, controle de qualidade, fornecimento de água, refeitório e manutenção de equipamentos. Na estrutura física da fabrica de ração, avaliaram-se as janelas, paredes, portas, pisos, coberturas, iluminação, ventilação, sistemas de proteção e acessos da fábrica. O sistema de controle de qualidade dos microingredientes, macroingredientes e produto final complementaram a avaliação. Os resultados permitiram concluir que a avaliação realizada na fábrica de ração não apresentou um sistema de controle adequado para produção de ração de alta qualidade. O sistema de gestão da qualidade utilizado, de acordo com a ISO 9000:2000, atendeu de forma incompleta as exigências da norma. As Boas Práticas de Fabricação (BPF) implantadas não foram atendidas em completo, na maioria dos setores. Todos os setores avaliados apresentaram problemas específicos que podem comprometer a qualidade do final produto.

Palavras-chaves: processamento, qualidade, segurança

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INTRODUCTION

The quality requirements of the concentrates have increased in recent years, mainly because the world economy is globalised and markets are more competitive. This shows that the ceaseless quest of profit taking, focusing on an analysis of reducing costs and increase in production, is not sufficient (Ropkins & Beck, 2000; Northcutt et al., 2003; Sperber, 2005). According to Snake & Rangel (1992), for businesses to survive it is necessary to seek new alternatives to set themselves apart from their competitors. The ways to maintain and win new markets are quality and productivity. The quest for quality and productivity is marked by various issues, such as quality management policies, analyzing the best production systems, training, maintenance of production, suitable choice of suppliers, and other factors (Chaves, 1980; Unnevehr, 2000; Scott et al., 2006; Coradi et al., 2009). According to Ishikawa (1993), for a product to obtain quality the following are necessary: rigid evaluation, control, and management at all processing stages of the product, involving all the raw materials, ingredients, the packaging, equipment, and operators. The same author said that this whole process should be developed, for the procedures are based on logic, according to the facts and data collected.

To produce safe food with better quality, researchers developed programs for quality management: the *International Standardization Organization* (ISO) 9000, the system of Hazard Analysis and Critical Control Point (HACCP), the Good Practices Storage (GPS), the Operational Procedures and Hygiene Standards (OPHS), the Good Practices Transport (GPT), the Good Manufacturing Practice (GMP), as well as others (Mortimore, 2000; Panizello & Quantick, 2001; Violaris et al., 2008). According to Motarjemi & Käferstein (1999), the implementation of programs for quality management is necessary for exporting countries. Ishikawa (1993) complements this by stating that the tools of quality management may contribute to the passage of relevant legislation and to inspections of federal bodies linked to the sector, and additionally decrease the losses in manufacturing processes and reduce costs, even with an increase of the production. The work had as its aim to evaluate the process, products and installation of a feed mill comparing with the quality aspects established by Good Manufacturing Practice (GMP) and Quality Management System (ISO 9000:2000) to feed mill.

MATERIAL AND METHODS

This study was performed in a poultry feed mill located in the Minas Gerais state, Brazil, with a production capacity of 1,000 tons of feed per day. As matérias-prima usadas na formulação das rações são provenientes de fornecedores distribuídos nas diferentes regiões do país, enquanto que, as rações processadas são destinadas aos produtores de aves da região da Zona da Mata, estado de

Minas Gerais, Brasil. The feed mill includes a parking area for grain trucks and automobiles, and also a weighing system of raw materials by automatic scale systems. The unloading of bulk products (corn and soybean meal) are performed in separated hoppers, while a manual system is utilized for individual units of sacked raw materials.

The grain pre-cleaning system consists of an air machine and sieves with a capacity of 600 ton.h^{-1} in which light impurities are removed. In this system the impurities and damaged grains are separated in the sieves based on different formats, according to the perforation standards of the sieves and the quality standards adopted by the industry. The grain drying is performed in a continuous flow dryer with a nominal capacity of 60 ton.h^{-1}. The product is transported within the mill by bucket elevators, belt conveyers and screw augers. Storage units consist of eight metallic silos, four with capacities of 1,200 tons each and the other four each capable of storing 2,100 tons. For corn storage, there are composts with eight more silos with capacities of 200 tons each. Theses silos are used during the highest harvest point in the final drying of products (dry aeration) to decrease the moisture content of the products from 16.5% to 12%. Soybean meal is stored in two cement silos with capacities of 350 tons each.

Another six metallic silos of 100 tons are also used for storage of soybean meal. Micro ingredients, including metionina, lysine, lime, salt, sodium bicarbonate, premixes, vitamins, and rice and wheat meals are stored in an internal area of the mill. Weighing of these ingredients is done manually and they are mixed in a pre-mixer. The ingredient mixing system for feed production is composed of a pre-mixer, mixers, and a hopper bin, with a capacity for 4,000 kg. The system is operated and controlled automatically by a computer. Weighing and addition of ingredients is done in a hopper for receiving of meals, doser and doser bins, oil (fat) tanks and a weighing scale. The control system is automatic and computerized for addition of the following products: soybean meal, wheat meal, corn germ, feather, visceral and meat meals and visceral oils according to the specific feed recipe.

After weighing and the addition of the ingredients, the products are ground simultaneously. The grinding system is composed of hammer mills, each with a rated power of 128.0 kW. Pelletization is performed with pelletizers presenting capacities of 25 tons each, operating at a temperature and pressure of 73 ºC and 750 Kgf.m^{-2}, respectively. After formation, the pellets are cooled to remove excess moisture and heat. The loading system of feed is in bulk, utilizing hopper bins and storage silos, with capacities of 60 tons each. Discharge is done directly in bulk feed trucks. The entire product transportation system in the feed mill is continuous. The grains, soybean meal, and other meals arrive at the feed mills by means of bulk trucks. Wheat and rice meals, as well as other micro ingredients such as premixes and vitamins, are transported to the

mill in trucks suited for transport of sacked feeds.

The feed mill has been using Good Manufacturing Practices (GMP) and Quality Management System ISO 9000:2000 as a benchmark for quality. The ratings for each item of the system of quality management were performed according to the criteria and attributes described.

Management responsibility (A): this item was assessed standardized quality policy signed and publicized policy knowledge levels organization, the indicators for evaluation and execution of policy, the definition of the organizational chart, the chart with the structure for quality, ranging from the management activities to the levels of inspection, the responsibilities and authorities of personnel quality, the representation administration for quality, formally designated the critical analysis of the quality system at predetermined intervals and records of the examination.

Quality system (B): in this section was analyzed, the quality manual, quality manual properly approved and disclosed within the company, the list of documents that make up each system function, a clear definition on the structure and hierarchy of these documents The documents properly deployed, the records of these deployments, the quality plan, product or manufacturing line, the plan implemented at the company and knowledge of everyone involved, the mechanisms to ensure understanding of customer needs and adapt the product and those responsible for analyzing the verification techniques and suggest improvements in methods and equipment.

Critical analysis of contract (C): in the accountability review process was evaluated, the case of doubts or uncertainties, definition of responsibility for contact with the supplier, the forms with information from the production process from suppliers, the procedures that provide for contract review, the checklists with the minimum specifications to be checked, the meetings scheduled with stakeholders to analyze the capacity to meet contracts for goods or special conditions, records of meetings, the definitions of responsibility for dealing with the client, the definitions of responsibility and method of communicating information of the amendments accepted to the productive sector, the records of activities.

Contract of Project (D): there are procedures for defining macros activities of a project, with defined responsibilities for each person, the plan for each project (flowchart) with the activities and responsibilities defined, plans relating to the areas involved and interfaces, coordination of design and form of information exchange, to define the responsibility for examining the input data and its interaction with the project, to define the responsibility for monitoring, analysis and output data records, as well as their compatibility with the production process, identification of critical points of the process and the necessary verifications, the meetings on the analysis of results for each critical phase of the project, documentation of meetings to define the

responsibility for approving the project, the definition of the form to pass design information for the production process and criteria for design changes, considering all relevant stages of development.

Documents of quality control and data system (E): procedures and manner of issuing documents, the criteria for development, review and approval, as well as the responsibility for these functions, the knowledge of the number of copies and their respective officers, identification and easy access to the copies, the procedures defining the form of document review, guidance for the care of older documents, analysis and implementation of changes to these documents, the log of changes documents and the contents or equivalent procedures to identify the current revision of the same.

Acquisition of products (F): were evaluated documents, defining the requirements of each material to be purchased, the documents stating all data necessary for purchase, as well as responsibility for the issue, the definition of the responsibility for effecting the purchase, the relationship of subcontracts possible for each product, the formal policy development subcontract, quality records for each subcontract, the checklists for the receipt of each material purchased, the criteria for acceptance and rejection of products, the criteria formally taken knowledge of the subcontract, to define the responsibilities of subcontracts, checking the premises of the subcontract, setting the inspection apparatus, costs, inspection plan and the degree of interference with the client on the subcontract, the criteria for qualification of suppliers and methodologies for selection of subcontractors.

Product control by client supplier (G): here analyzed the specific procedures for handling materials received from suppliers, the procedures defining the responsibility of allowing this system, the criteria of verification, such as sampling, criterion acceptance and rejection notices and the procedures defining the conditions of maintenance of equipment, procedures defining the conditions of storage and handling of this material, to define the responsibility for treatment with the supplier in case of loss, damage or inadequacy of the definition responsibilities of the supplier as to the product supplied to the end, the tracking systems ensuring the correct use of products supplied to the merger.

Identification and traceability product (H): there were procedures for identification of products during the receipt of raw materials, production processes and the stage of shipment, the time to file these identifications.

Process control (I): were evaluated in this item, the identification and planning processes, identifying and planning processes of assembly, installation and after-delivery, procedures that ensure implementation in accordance with the requirements imposed by the process , a clear definition of equipment to be used, defining the special procedures of the company, setting the requirements for

qualification of procedures, qualification of operators for special cases, the records of qualification, equipment maintenance plans that affect the quality, specific procedures for maintaining each type of equipment, records of maintenance, the criteria defining the environmental conditions of work such as lighting, ventilation, dust, etc.., plans for corrections or adjustments to the conditions and the documents defining the conditions production, assembly and installation, detailing the equipment, sequence of operations and working methods.

Inspection and testing products in the receiving (J): in this stage, there was incoming materials, the definition of the sector, the check as the quality plan and documented procedures, materials released into the scheme and registered to ensure its tracking, the definition of authority for the release and identification of non-conformity.

Inspection and testing in the productivity process (L): aimed to evaluate this item, the product verification as quality plan and documented procedures, the products retained until the release by the responsible sector, the definition of the sector, identifying the products nonconforming.

Inspection and testing the final product (M): there are those products as the quality plan and documented procedures, ensuring that all customer specifications are being contemplated for customized products, defining the authority to analyze the results , final inspections of records showing that the acceptance criteria were met, the definition of the form file and the time those results, the security that no product can be shipped without the release of the industry competent authority for the definition of liberation.

Equipment control of inspection and testing (N): evaluated the documents defining the type of equipment to be used in each scan, a list of all equipment used to identify equipment, the plan for equipment calibration intervals predetermined, the criteria for contracting services for calibration, the calibration records, how to identify the validity of the calibration, the procedures for calibrations performed at the company, the definitions of the criteria for rejection and adjustments, the criteria for action to be taken when results are unsatisfactory, the tracking of equipment out of calibration, the procedure implemented for handling, preservation and storage of equipment, the guarantee of environmental conditions on local calibration, storage and verification, the inclusion in the calibration programs patterns, jigs and devices.

Situation of inspection and testing (O): were analyzed the documented procedures ensuring the indications of the state inspection, state inspection, the statement maintained throughout the process to ensure that only approved to be used or shipped, the differentiation among the products approved and notified.

Control of non-conforming product (P): were evaluated the procedures to ensure non-compliant materials are not used, the

procedures for identifying, reporting and segregation of non-conforming, the procedures for disposition of nonconforming material, responsibility for the provision, the procedures for analysis of nonconformities in order to seek continuous improvement, the definition of responsibility for analysis, the procedures defining conditions assessments for materials, procedures defining responsibility for client contact nonconforming materials**.**

Corrective action Preventive action and (Q): were evaluated the preparation of documents that describe the non-conformities in the process and post-delivery service, the procedures for considering the reports, research and suggestions for corrective actions, defining the procedures of steps implementation, accountability and verification of the effectiveness of corrective actions, records of corrective actions, procedures, research of potential causes of nonconformities, the procedures defining steps for implementation, accountability and verification of effectiveness of preventive actions, records of actions preventive.

Handling, storage, packaging, preservation, and delivery (R): an evaluation of the documents that define the steps to be taken when handling raw materials, appropriate sites for storage of raw materials, ensuring their integrity, conservation and segregation, control of raw materials in order to be used within the criteria of rotation and within the period of validity, the assessment at regular intervals the state of the raw materials stored, the documents that define the steps to be taken when handling semi-finished products, the documents defining the packaging for finished goods, the procedures for storage, inventory and order materials, procedures for loading and transportation of materials to be shipped to define the appropriate location for storage of finished products definition of responsibility for preserving the quality of products released in the final inspection and the determination of the appropriate methods for authorizing receipt and dispatch areas of stock.

Control of quality registers (S): if there was a definition of procedures for the collection and analysis of records, the list of documents that are considered records of quality, the definition of procedures for indexing, storage, archiving of records, the establishment of the file time, the establishment of an appropriate location for the storage of files, the files available to the client in simple and practical way, when a contract, security procedures, appropriate custody and access files on computers.

Internal quality audits (T): were analyzed the system of internal audit quality, defining the periodicity and trained personnel for this purpose, the audits scheduled in advance required, considering the current situation and the importance of the activities, personnel selected in order to necessary independence to auditors in relation to its audited, the information systems audits with their respective results, the documentation for the review of audit results, the elaboration of action plans to correct points found in non-

compliance audits, with the designation of responsible and deadlines, the implementation of fixes and improvements and the record of the fixes and improvements.

Training of people (U): if there are procedures for identifying training needs, the systematic planning of training to be done, staff training, records kept of training, records of courses taken outside the company, the relationship functions which are required expertise, they need a special qualification, certain procedures for the qualification and classification of people according to the procedures.

Associated services (V): an evaluation of the documents defining what the company provides associated services, the services or internal sectors responsible for handling complaints or suggestions of users and providers, the records of complaints or suggestions and analysis by health authorities of company, the records for analysis and reporting activities, the procedures of how a company must meet and deal with these customers, the procedures for verifying the effective implementation of the improvements or fixes, the mechanisms for checking the degree of customer satisfaction with services or the company's products and sectors responsible for data analysis.

Statistical techniques (X): were discussed the plans that clearly define where you need the specific statistical techniques, the application of statistical techniques as defined in the procedure, the personnel that uses statistical techniques, internal sectors responsible for the development of techniques as well as for data analysis. Figure 2 shows the number of questions applied to each item's quality management system ISO 9000:2000, the assessment of products and sectors of the feed mill. Through interviews, questionnaires applications to immediate technical managers from every sector, it was evaluated the quality, related to raw materials, finished products, sectors, facilities and infrastructure that comprise the feed factory. In the administrative sector of the feed mill evaluated the items related to the responsibility of management, contract reviews, project contracts and outsourced services. With those responsible for quality evaluated the quality system, document control and system data quality, identification and product traceability, process control, inspection and testing upon receipt of products, production process and finished product, control of nonconforming product, quality records, internal audits of quality, training people and the statistical techniques used to evaluate products. With those responsible for equipment maintenance sectors evaluated the work system and the actions on the control of inspection, measurement and testing, and corrective and preventive actions. In the commercial arena, we evaluated the system control and acquisition of products from suppliers. In the manufacturing sector were assessed handling, storage, packaging, preservation and delivery of products.

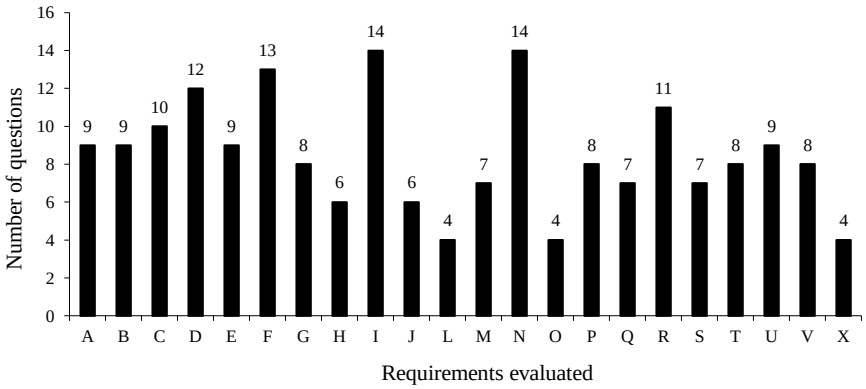

FIGURE 1. Number of questions evaluated for each requirement of the system ISO 9000:2000.

In evaluating the quality of raw materials and finished feed were analyzed the performance of the program's tools ISO 9000:2000 (Figure 2). At this stage, we observed the results on quality control of raw materials on the quality of the final product, according to the diagram in Figure 2.

Evaluating the quality of the sectors of the feed mill and processing steps, based on the ISO 9000:2000 program. Individual results of the quality of each sector were analyzed on the general context of the production system, according to the diagram shown in Figure 3.

For each production sector were assessed the physical plant feed mill (Figure 4), based on the Manual of Good Manufacturing Practices (GMP) developed by the National Association of Animal Feed Industry.

For the evaluation of raw materials, final products and sectors of the feed mill, grades 0-5 (Table 1) as the level of implementation of the items assessed the Quality Management System ISO 9000:2000. The average scores determined the final quality of the system. In the evaluation of the plant feed, according to the standards of Good Manufacturing Practices, grades 0-5, as the level of implementation and concepts (Table 2). The average scores for each item evaluated determined the final quality of the facilities.

RESULTS AND DISCUSSION

Figure 5, the raw materials and processed feed were evaluated. Notes that the requirements evaluated concerning the management responsibility, the quality system, the critical contract analysis, the documents control, quality system data, the inspection control equipment, the measurement, the preservation and delivery, quality internal audits and training were allocated notes between 3 and 4 characterizing as implementation levels "partial" and "formal".

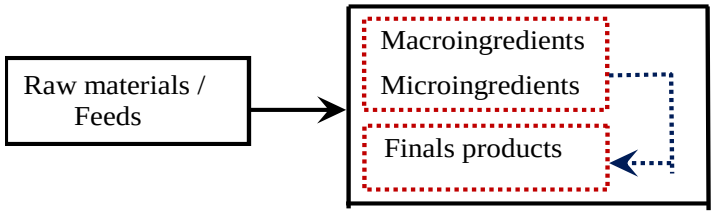

FIGURE 2. Products utilized in the feed mill.

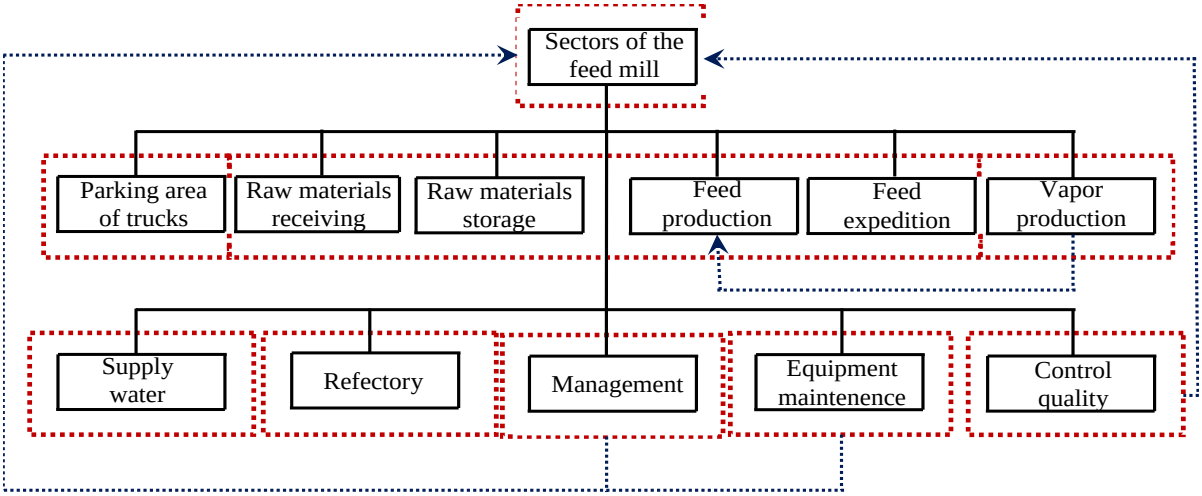

FIGURE 3. Diagram of sections of the feed mill.

FIGURE 4. Physical structure of the feed mill.

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TABLE 1. Notes and implementation levels used for the evaluation of raw materials, final products and sectors of the feed mill according to the guidelines of the Quality Management System ISO 9000:2000

Notes	Implementation levels
0 – 1	not attended
1 – 2	attended partly, in an informal way
2 – 3	attended fully, in an informal way
3 – 4	attended partly, in a formal way
4 – 5	attended integrally and informally, subject to improvements
5 – 6	fully attended
N. A.	not applicable

TABLE 2. Notes and concepts used for the evaluation of the plant feed, according to the guidelines on Good Manufacturing Practices (GMP)

Notes	Implementation levels	Concept
0 – 1	not yet implemented	Insufficient
1 – 2	in initial implementation stage	Bad
2 – 3	at the level of partial implementation	Regular
3 – 4	implemented recently	Good
4 – 5	fully implemented, there is at least one year	Optimum
N.A.	not applicable	-

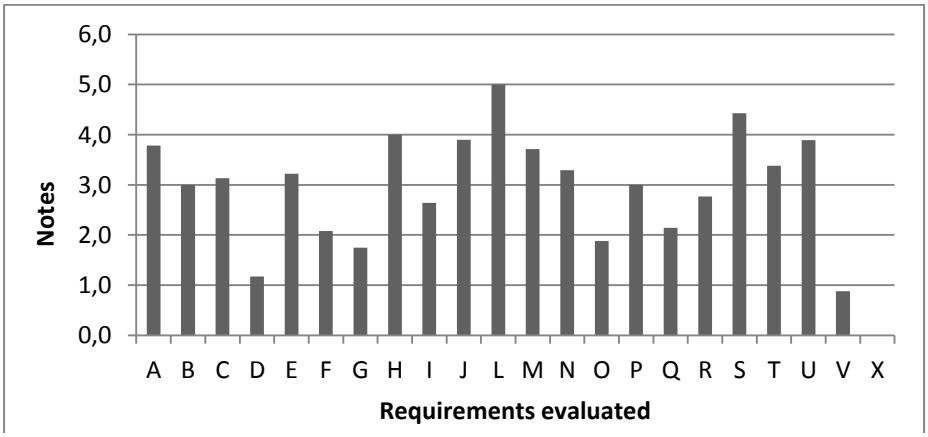

FIGURE 5. Evaluation of the products received and processed in the feed mill (ISO 9000:2000).

The "partial" requirements implementation may mean in "stage of development", when it was observed that the involvement of the people in the proceedings know the importance and what is happening, from the idea of compromise to the activities as "formal". However, when there is no adequate control regarding the requirements for management responsibility, it is worrying for the company. This requirement is preeminent and necessitates a quality policy coherent with its objectives and goals, ensuring its understanding and implementation at all levels of the organization define the tasks and responsibilities by the various activities that affect the quality to make the resources and personnel trained for the implementation of the activities and to examine critically the quality system to ensure the adequacy and effectiveness in achieving the objectives of quality. The preparation of a quality manual and setting forth documented procedures is of fundamental importance. Once this requirement is implemented partly, there may be problems in the standardization of quality management systems.

Critical Contract analysis is geared in the sales procedure, and when it not serviced totally, it interfere in the company organization. The inspection control of equipment, measurement, and testing are referred to control of the products and to control the processes. The "partial" service is directly related with the equipment selection, regular calibration, elaboration of procedures for calibration and equipment identification. Other requirements, such as the internal audit and the staff training system, when carried out partially, directly affects the productive processes of the industry, since there is no assessment of performance of the activities and persons without knowledge of the manufacturing processes. This assessment of requirements looked at the management system, only inspecting and testing the productive processes "note average equal to 5 and implementation level "total"". On the other hand, in the inspection tests carried out in the receiving stages and for the finished product, the notes were between 3 and 4, and level of implementation was "partial". Notwithstanding, it was observed in the evaluation context that the people who are directly involved with these requirements are aware, "formal", the need for greater development and good management.

The inspection activity must be continued for products received of suppliers in the productive process, and in the final products. This management requirement, when not serviced adequately, could compromise the standardization and quality of products manufactured. According Moura & Carillo (1994) defining inspection criteria, verification, and the testing of products can provide agility and quality in implementing these activities. Lamprecht (1995) stated that to thrive in this stage we need to involve the performance assessment of suppliers, assessing the ability of procedures, planning of

inspections and tests, elaboration of procedures of inspection and tests, the preparation of quality standards, selection of inspection instruments and testing, inspection and testing in the various stages of proceedings and release of the product to use. The assessment sequence, the requirements for identification, and traceability of products, records control of the quality received notes medium, between 4 and 5, implementation levels "full" and "Informal" and with possibility of improvements. In this evaluation was observed lack of information in the sectors of work, instead that all should be committed with the same information to develop and systemic continuous improvements in procedures.

The importance of identification and traceability of the product are also explained by Maranhão (1993), when he says that the main concern with these requirements is the customers, that main more adequacy to the principles of quality with implantation of programs of the quality management system. In the assessment of the acquisition requirements, control process, control of non - conforming product, corrective action and preventive action, handling, storage, packaging, preservation and delivery, the banknotes allocated were between 2 and 3 of implementation level "full" and "informal". In these requirements, in which the staff are involved the information are not clear "informal" to implementation procedures. The acquisition is a part of the supply process of the company and the quality of any product depends on the ability of suppliers to produce acceptable products. This is important to have all the information providers to acquire quality products. The control procedure is done in production and where applicable it extends into the activity of installation and in the associated services for the sale of the product. We need to implement good planning for process control, which requires evaluation and selection of equipment and the working environment for the task's implementation.

The department of engineering and its efficient use of statistical techniques shall enter here in this phase. The failure to control the production processes and quality may occur in the manufacture of non-conforming products, and these must be duly identified, documented, evaluated, segregated, prepared and notified for the duties involved. According to Lamprechet (1995), adopting procedures for corrective and preventive actions help to control this type of problem. In the handling system, storage, packaging, preservation and raw materials delivery, processed material or finished products may suffer damage from shortcomings in these activities. Therefore it is important to know and to maintain the procedures for these activities. In the assessment of project control requirements, the product for which control was supplied by the customer and the inspection and testing situations were allocated notes averages between 1 and 2, implementation level "partial" and "informal".

The partiality of the results indicates that the requirements are evaluated in incomplete implemented form. For the project control, this represents bad planning and disorganization of technical responsible for the activity. In the control of the product supplied by the client process partiality and informality was observed, because the company does not maintain control procedures, and does not verify the storage and maintenance of such products (Rothery, 1993; Coradi et al., 2009). The inspection verification and tests should be carried out in the various stages of production. The inspection in the entry of products is carried out only in withdrawals. Among the requirements evaluated, without doubt the associated services and statistical techniques had the worse results. The notes allocated in the evaluation concluded that the associated services did not answer the quality indexes for the implementation, and there are not clear procedures for the statistical techniques application to analyze the processes.

Figure 6 shows the results for Good Manufacturing Practice implemented in the feed mill. In accordance with the results, the item "doors" obtained in the evaluation notes between 4 and 5, the concept "optimum", and implementation level "total", taking into account all the quality requirements according to the manual of GMP (Sindirações, 2006). In different areas of the feed mill doors and gates are made of metal frame and canvas, good resistance. In some sectors, such as labs and locker rooms, entry doors should be self-closing. For the items "roofs", "windows", "walls and divisions", "illumination", and "ventilation", received notes between 3 and 4, concept "good" and implementation level "recent". For the evaluated items "access", "floors" and protection were allocated notes between 2 and 3, the concept "regular" and implementation level "partial".

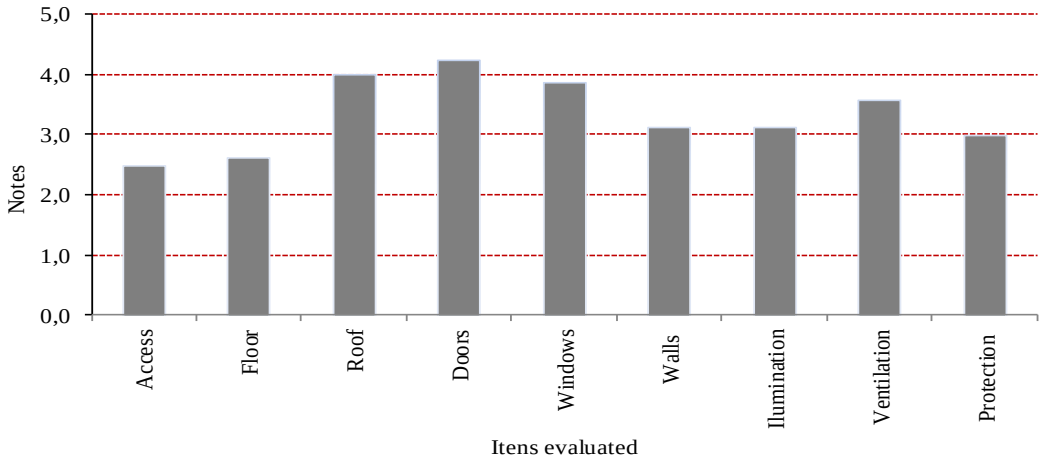

FIGURE 6. Evaluation of the physical structure of the feed mill, based on GMP.

The coverage of the feed mill is a metal structure and asbestos tile or zinc sheets, with one or two waters, with or without rail systems, depending on each sector. The major problems identified in the roofs are the accumulation of waste materials, may cause over time, leaking water to the inside of the factory. In other situations there were holes, cracks and moisture in the walls due to improper sealing of some critical points. All windows are metal frame with screen or glass in good condition. To prevent the entry of sunlight and glare from the windows still have some areas with curtains for protection. In the laboratory, for example, windows are protected with millimeter screen, preventing the entry of pests. In the sectors of production and storage of rations and the windows are used for air circulation and inspection of equipment and products. The walls that make up the feed mill are of masonry or metal structure. Some sectors are separated from the others, with walls of canvas, wood or glass.

The walls are easy to clean, but low height, inadequate in certain situations. The main problems observed in the walls were the wear of materials, cracks and not sealing, allowing contact of moisture with the products. The artificial lighting systems in some areas have glare, shadows and contrasts, making viewing difficult and the work of employees. The systems used for ventilation at the mill are air conditioning and natural, able to ensure the thermal comfort of sites. In the sectors of production storage and air circulation is natural via doors and windows, no ventilation system and air insufflations. Observed in these environments, large amounts of dust, particulate matter, gases, smoke and smell. In the sectors of administration, laboratories and meeting rooms, the rooms are air conditioned.

The floors used in the manufacture of fish feed of slurry, concrete or ceramic, smooth and easily cleanable. Cracks, holes, scuffs and low slope, causing the accumulation of water and waste are the main problems observed. In the area of parking, ground floor hinders the movement of trucks, particularly in times of rain. The approaches are well marked and separated individually and meet the needs of industries. The spaces for the flow of trucks and vehicles are reduced, potentially causing the queues.

Figure 7 shows the results on the assessment carried out for each sector of the plant. In the sectors evaluated were observed that the best quality results, with notes between 3 and 4, concept "good" and implementation level "recent" were the items “management”, "control quality”, “vapor production”, “supply water,” “refectory” and “equipment maintenance”. For other sectors evaluated, "parking of trucks”, “raw materials receiving”, “raw materials storage”, “feed production” and “feed expedition” were allocated notes between 2 and 3, the concept "regular" and "partial implementation".

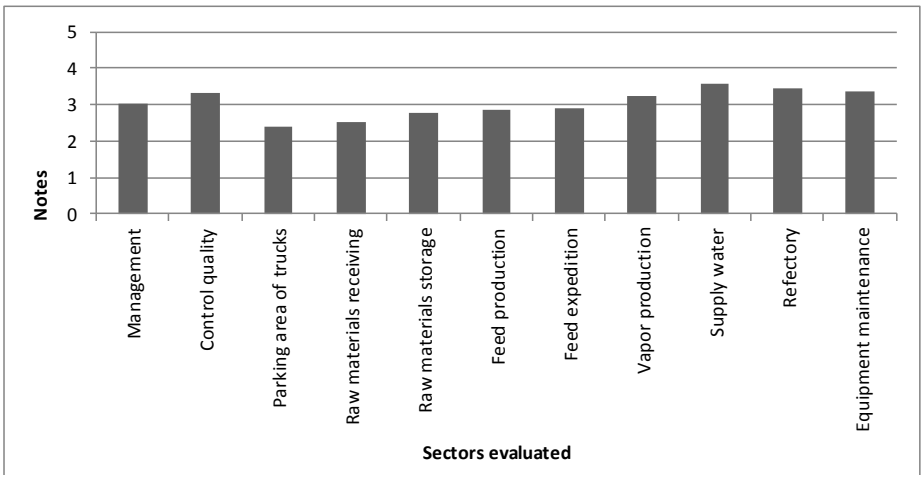

FIGURE 7. Evaluation of sections of the feed mill, based on GMP.

Observing the diagram of Figure 4, the sectors that manage the entry and exit of products, the system of production, shipment and quality control and maintenance of equipment directly or indirectly have an influence on the overall quality of the other industrial sectors. The areas are not entirely adequate, the structure presented bad conservation status, there is a program for washing and pest control, and however no preventive maintenance of equipment. The cross-contamination occurs due to the lack of separation of dirty and clean work areas. It was found that the production system of steam used in the pelleting process is sufficient but higher dimensioned than it needed to be to work. The evaluation underlined the poor pest control and prevention. The lack of equipment and machine cleanliness was proven by high contamination indexes in the different sectors of the mill and the absence of an appropriate traceability program for products (Coradi, et al., 2009).

CONCLUSIONS

The quality management system used in the feed mill according to ISO 9000:2000 falls short of the standard requirements. The Good Manufacturing Practice (GMP) located in the feed mill is not in full use in the majority of sectors. The installations and sectors evaluated for the feed mill showed problems that compromise the quality of the product which are manufactured.

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