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INTRODUCTION

Modern firm manufacturing mineral water diligently protects its bore holes using cameras and security service. Water from water bearing deposit is poured into bottle in sterile conditions. Production lines belonging to the so called clean zone are computer controlled, workers supervising production are wearing protective clothes and have to have suitable health certificates. Bottles moulded in temperature 200°C are washed with a special stream of water before filling. Technological air used to pneumatic control of the production line is cleaned in three different types of filters which guarantees its sterility. The quality of water from the bore hole and the final product are examined by the factory laboratory.

The purpose of the work is to present the rules of natural mineral waters quality control from the health safety side connected with water consumption.

WATER IN HUMAN BODY

Water volume (V) in human body can be preliminarily estimated according to the Fris-Hansen formula (Hałat, 1998):

$$V = 0.55 \cdot \text{weight [kg]} + 0.5 \text{ dm}^3 \quad (1)$$

Proportional portion of water in human body depends on age and gender. At young women it is 50%, and at men 60%. At people over 60 the proportional portions are, respectively, 45% and 50%. Brain and muscles at adult person contain about 75% and blood about 87% of water. Twenty four hour's water requirement in human body is from 2.0 up to 3.5 dm^3, depending on the physical activity and ambient temperature. In twenty four hour's balance one should take into account the metabolism processes which produce 0.2 up to 0.6 dm^3 of water. For example, while 1 g of protein is burnt 0.41×10^{-3} dm^3 of water is produced, 1g of fat — 1.07×10^{-3} dm^3, and 1 g of carbohydrate — 0.6×10^{-3} dm^3 (Hałat, 1998).

With regard to consumers feelings the organoleptic properties of water, such as: taste, colour, transparency and smell are subject to estimation (Rak, Tchórzewska-Cieślak, 2005).

QUALITY SYSTEMS IN MINERAL WATERS PRODUCTION AND TRADE

Guarantees and safety of mineral waters consumers can be assured by the following quality systems (Głodkowski et al., 2004):

- management in order to achieve quality — Quality Management — QM,
- analysis of threats in critical control points — Hazard Analysis Critical Control Points — HACCP,
- risk analysis and biocontamination control — Risk Analysis Biocontamination Control — RABC,
- good hygienic practice — GHP,
- good manufacturing practice — GMP,
- early warning about dangerous food — Rapid Alert System for Food — RASF.

The rules of GHP and GMP are implemented before HACCP is introduced (Głodkowski et al., 2004).

Quality systems concerning mineral waters production and trade define the mentioned below terms in the following way:

- threat — biological, chemical or physical factors which can occur in mineral waters and cause the negative consequences for human health (Rybicki, 2004),
- monitoring — system of processed observations, measures and studies having a specified aim, performed on the representative samples,
- risk — danger that the negative severe consequences for human health will occur as a result of mineral waters drinking,
- risk analysis — procedure consisted of three interconnected elements including risk assessment, risk management and information about risk,
- risk estimate — scientifically aided process consisting of three stages containing threat identification, characteristic of danger, hazard assessment and risk characteristic,
- risk management — action undertaken by the suitable body supervising safety of using mineral waters that establishes the ways to prevent risk and to control risk, based on the risk estimate and binding requirements regarding sanitary and hygienic safety at production and trade of mineral waters,
- information about risk — it means to exchange information and opinions regarding threats and risk as well as factors connected with risk, during risk analysis, among those who estimate risk, manage risk, consumers, producers, traders and scientists,
- procedure — it is an established way of action — description of operations allowing to perform some task,
- instruction — it is an operational procedure of lower order — it gives detailed actions in logical sequence of execution, describes step by step the task connected with the given position, explains the way of carrying out.

THE HACCP SYSTEM METHODOLOGY

As results from the rules of the HACCP system, it is a proceedings which aim is to ensure mineral waters safety by the identification and the evaluation of a threat scale, from the point of view of a curative quality and risk of threats, during the course of all production stages and trade of mineral waters. The purpose of this system is also to determine the methods to reduce threats and to establish corrective actions.

The HACCP system regarding food control came to existence in the USA in the late 1960s, ordered by NASA (National Aeronautics and Space Administration). The origin of HACCP was related to the scientific research on production of food without pathogenic microorganisms for the astronauts (Głodkowski et al., 2004).

In 1971 Pollsburgy company presented this system at the American National Conference for Food Protection. The HACCP system has been accepted by World Health Organization (WHO) and International Commission on Microbiological Specifications for Foods (ICMSF).

As a result of the fact that Poland joined the European Union the sector dealing with mineral waters production and distribution has been obliged to use the HACCP system. It is regarded as the most efficient tool which guarantees that water as a foodstuff will not be polluted or conta-

minated and will be safe for consumers health. The HACCP system is created individually for every production line and distribution type, taking into account the specific character of the given activity.

The main rules are the following:

- the identification of the possible biological, chemical and physical threats and the methods of counteractions,
- the prevention, in form of a control of the particular phases of mineral waters production process and distribution, not the final product only,
- it is used in the whole production cycle: from water intake, then bottling plant, warehouse, distribution, delivery to consumers in stores and restaurants.

There are seven basic stages connected with the HACCP system implementation (Głodkowski et al., 2004).

Stage 1. Threats analysis.

It consists in:

- the identification of the potential threats in the categories of occurrence: biological, chemical, physical,
- the establishment of a source and a reason, as well as the preventive activities,
- the assessment of risk of threat (Rak, Tchórzewska-Cieślak, 2005).

Stage 2. The establishment of critical control points (CCP).

It enables to achieve the purpose of the system by being in control of mineral water sanitary safety. The condition of CCP determination is the possibility of their monitoring and the possibility of real threat controlling. To determine CCP one can use a decision tree method. It allows to determine CCP by the logical series of questions and answers concerning the possibility of eliminating the threat in a given point or reducing it to the acceptable level. An example of decision tree questions, according to Dutch procedures can be found in (Głodkowski et al., 2004).

Stage 3. The establishment of the critical limits for every control point.

After the CCP designation one should determine one or more indicators of contamination which will be controlled and the desirable values, the limits of tolerance and the unacceptable critical value (Dz.U. 2006 nr 171 poz. 1225). The criterion for the choice of the indicator should be speed and easiness of measurement and the possibility of monitoring. In case of difficulties one should use the visual and/or sensor assessment.

The microbiological examination and the examination of sanitary and hygienic state of water at its intake and in the consumer package are conducted to ascertain (Dz.U. 2004 nr 120 poz. 1256):

- lack of parasites and pathogenic microorganisms,
- lack of Escherichia coli and other forms of coli bacteria in 250 cm^3 in temperature 37°C and 44.5°C,
- lack of streptococcus faecalis in 250 cm^3,

- lack of Clostridium reducing sulphates in 50 cm^3,
- lack of Pseudomonas aeruginosa in 250 cm^3,
- total amount of bacterial colonies growing from 1 cm^3 of water:
  - in temperature 20–22°C during 72 hours in agar or in the mixture of agar and gelatine is not higher than 5,
  - in temperature 37°C during 24 hours in agar is not higher than 20.

Stage 4. The establishment of CCP monitoring procedures.

The CCP monitoring is a base of the HACCP operating. The results obtained from the monitoring have to be recorded. For monitoring procedures one should determine:

- a method of monitoring,
- a character, constant or periodical,
- a periodical monitoring frequency,
- a way of supervision,
- the rules of measuring device control and calibration.

In Table 1 the range of mineral waters quality examination within the framework of CCP monitoring during production is presented.

Table 1. The range of mineral waters quality examination within the framework of CCP monitoring.

Type of water quality rating	Range of monitoring
Organoleptic rating	smell, taste, turbidity, colour
Physical and chemical rating	conductivity, pH
Undesirable components in excessive concentration	nitrates, ammonia nitrogen, iron, COD
Basic components	characteristic components mentioned in water marking

The microbiological, physical and chemical determination of water quality in 5 bottles randomly taken from different production batches are performed within twenty four hours. The so called keeping quality examination that determines water quality before its consumption expiry date is also performed (Dz.U. 2006 nr 85, poz. 544).

Stage 5. The establishment of corrective actions.

Corrective activities have to be undertaken when monitoring shows the trend to exceed permissible values of cleanliness rating or such values are exceeded. The possibility of stop in mineral water production process should be predicted, in order to eliminate the causes of the necessity of the corrective actions.

In tab. 2 the maximum concentrations of chosen mineral waters components, when their quality is corrected by permissible process of water ozonization, are presented.

In order to regard water as curative the clinical and pharmacological examinations, according to the scientific methods, which estimate natural mineral water properties and its impact on human body, such as: diuresis, stomach and bowel functions, balance in mineral elements, should be carried out. In natural waters having components good for health the general water proper-

ties resulting from quantity proportions between macro and micro elements are essential. As an example one can give the desirable proportion of the contents of calcium to magnesium: 2:1.

Table 2. Maximum limits for components that remain or are created during aeration of natural mineral water and spring water by ozone enriched air.

Kind of component	Maximum limits (μg/dm^3)
Dissolved ozone	50
Bromate	3
Bromoform	1

Stage 6. The establishment of system verification procedures.

Verifications are performed after the HACCP system is implemented as its first evaluation. Then a frequency of next verifications should be established, verification is always performed after the changes in the technological production process are made and also when the undesirable events occur.

Effectiveness of the HACCP system can be verify by means of external and internal audits. There is the possibility to achieve HACCP certificate which definitely increases confidence of the present and the future consumers of the given mineral water brand.

Stage7. The creation of documentation.

System documents should contain a plan of HACCP and the records testifying system operation. The way of documents drawing up, storage and supervision must be establish.

CONCLUSIONS

- The HACCP system is one of the systems to ensure mineral waters quality and curative values. The implementation of the system increases the confidence among the particular participants of mineral waters market. The beneficiaries of the effects of the HACCP system introduction are producers, sellers, supervisor service, and, most of all, mineral water consumers. The efficient HACCP system allows to avoid the groundless complains, protects against the loss of customers and credibility of the firm on the market.
- The external benefits of the HACCP introduction for mineral waters producer are the following:
  - the increase of consumers confidence,
  - the opportunity of sale in the European Union markets,
  - the improvement in product competitiveness,
  - the improvement in firm image,
  - the increase of confidence at official inspection units.
- The HACCP system means a change in the way of evaluation of mineral waters quality as a product. The evaluation of the conditions of high quality mineral waters production, instead of the control of the final product only, ensures the increase of health safety connected with their consumption.
- There are some possibilities to develop the method to assess the risk of threat, based on the three and four parameter matrix for risk analysis and evaluation (Rak et al., 2005).

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