IMPROVING FOOD RADIOACTIVITY MONITORING PROCESS IN THE LABORATORY OF THE NUCLEAR RADIATION HYGIENE FROM SIBIU PUBLIC HEALTH DEPARTMENT

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ABSTRACT: In this paper, the authors highlight the main problems faced by the Laboratory of the Nuclear Radiation Hygiene from Sibiu Public Health Department and propose a improvement methodology for its using the DMAIC model. The authors also present the effects produced from these problems or they can produce if not properly resolved. Effects, which affect or may affect both food manufacturers and final consumers through the negative influence on the businesses and on the public health.

KEY WORDS: public health, food, nuclear radiation, improving, DMAIC.

1 INTRODUCTION

1.1 Some aspects regarding the impact of radioactivity on human health

Pollution or radioactive contamination is defined as the presence in or on the surface of environmental factors or living organisms to radioactive materials from human activities, situations where the radioactive exceeded their natural environment or the body and which may cause effects adverse human health.

It can produce a complex of radioactive contamination of the environment both naturally occurring radionuclides (C-14, K-40, Pb-210, Na-24, U-235, Po-210, U-238, Th-232, and so on) and with artificial radionuclides (I-131, Cs-134, Sr-90, I-152, I-132, and so on).

The Supervision activity of the radioactivity of food, drinking water and of the environmental factors with radioactive content of which contribute to radiation exposure of the population, ensures the maintenance of the effective dose by ingestion within the limits of rules and the responsibilities for this belong, in Romania, of the public health system (Dumitrescu & Milu, 1997).

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1.2 Short description of the six sigma methodology

Six Sigma started at Motorola in the 80s as a challenge to achieve a reduction in the number of defective products. To achieve this effect it took a thorough analysis of the causes and possible correction. Motorola has published the mid 90s detail its quality improvement framework, which have been adopted since then by numerous organisations (Kifor & Oprean, 2006).

The term and innovative 6 Sigma program became recognized only in 1989, when Motorola announced it would get a fraction less than 3.4 defective product for a total of one million in less than five years. This statement radically changed vision of quality: from one where the quality is measured in percent (number of parts in a hundred), to a level which is referred to one million or one billion (Kifor & Oprean, 2006).

The aim of this method is to obtain products and processes without defect. The most famous model of six sigma methodology application is the DMAIC model This model includes a series of steps, grouped by type of activity (Fig. 1).

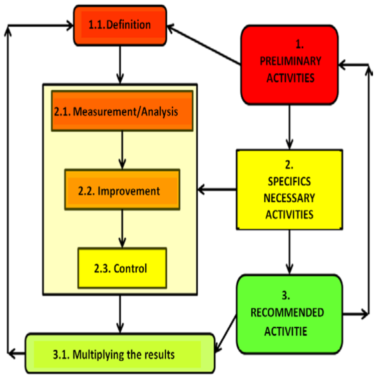

Figure 1. Six sigma methodology. The DMAIC model

2 CASE STUDY

2.1 Definition

Firstly, in this part the authors present the problems facing the laboratory, like:

- lack of human resources;
- missing materials;
- lack of financial resources;
- obsolete equipment;
- disregard the number of samples of methodology health programs.

These are some of the issues analyzed in the last session of the management review.

Then we evaluated these problems by using the evaluation matrix of issues.

For compiling the evaluation matrix were identified following criteria:

- *chronicity* - the project must correct a problem that occurs frequently, not a recent one;
- *duration* - Projects must have a duration of less than one year;
- *urgency* - if the project is urgently address issues that make the organization vulnerable in relation to the environment;
- *possible resistance to change* - choose the project that probably will encounter the least resistance;
- *problem must be measurable* - the project does not commence unless the necessary data has.

To assess issues were given scores on a scale from 1 to 5 where: 1 issue less important; 5 - very important issue.

The selection criteria are weighted according to importance (Table 1).

Table 1. Evaluation matrix

Criteria / Problems	chronicity 0,3	duration 0,2	urgency 0,3	possible resistance to change 0,1	problem must be measurable 0,1	Total
lack of human resources	5	2	3	5	3	3,6
missing materials	4	3	3	2	3	2,9
disregard the number of samples of methodology health programs	5	3	4	5	5	**4,5**
obsolete equipment	5	2	3	1	4	3,3
lack of financial resources	5	2	3	5	5	3,8

Based on the scores obtained in the "evaluation matrix" that the most important issue is the number of samples from the methodology of the health programs.

Then we define this problem: In the past 10 years they have made only 75% of the samples planned methodology.

After this we define the mission: Increasing the number of samples by 10% by the end of 2015.

To fulfill this mission it was necessary to involve the next team colleagues from the Public Health Department Sibiu:

- the head of department;
- a chemist;
- and a hygiene assistant.

2.2 Measurement and analysis

To achieve the objectives was studied six food groups (milk, meat, fish, potatoes, fruit, and eggs), for this was performed alpha and beta radioactivity measurements overall.

The period under study is 1995-2014, so analysis will be done so throughout to this period and in the last 10 years (2005-2014).The period under study is 1995-2014 analysis will be done so throughout to this period and in the last 10 years (2005-2014).

Because, in Romania, are not established the limits values for alpha and beta global radioactive content of food, procedure consists in the establishment by each accredited laboratory of references values for each food group.

We started up the measurement and analysis by defining limits in the relevant project for improvement.

Defining the limits is the stage that indicates where the project starts and ends.

Thus, we developed a general flow diagram (Fig. 2) to the analysis of global alpha and beta radioactive contents for the main food groups (milk, meat, fish, potatoes, fruit, eggs).

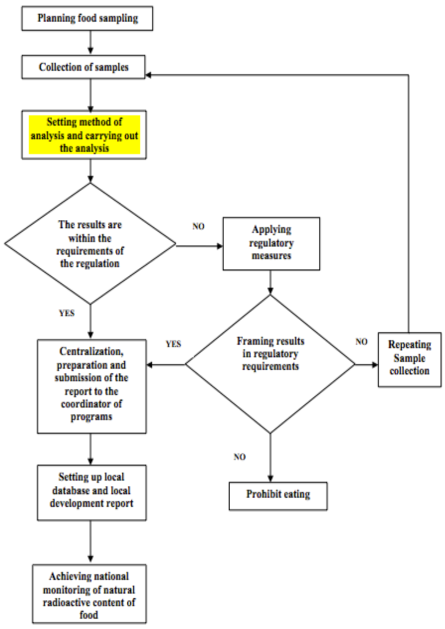

Figure 2. General flow chart of the process of analyzing the global alpha and beta radioactive contents

To identify the causes were analyzed work reports and complaints made by employees, to the management of the Public Health Department, in the last 20 years. In this way we established the frequency for each cause. All these data are synthetically presented in Table 2.

Table 2. The main causes identified

Causes	Frecvency
Few employees	420
Untrained employees	10
Inattention of employees	6
Fatigue	5
Obsolete equipment's	250
Unstandardized equipment's	12
Uncalibrated equipment's	8
Maintenance unenforced	20
Legal requirements sample number	280
Legal requirements for term	50
Legal requirements for equipment	150
Legal requirements security	100
Missing Budget Minister	25
DSP internal management budget	170
Management at laboratory	15

The data collected have been analyzed and ranked using Pareto chart (figure 3).

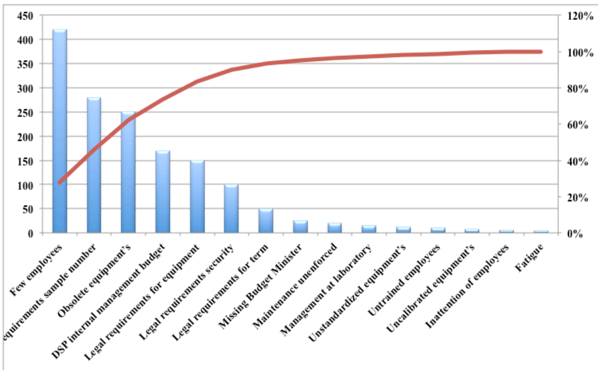

Figure 3. The Pareto diagram

2.3 Improving

As can be seen from the Pareto chart the top four causes generates 74% of the issue.

For these causes we have developed a number of alternatives for improvement that were assessed using a matrix for selecting the alternatives (Table 3).

Table 3. The alternatives selection matrix

Causes	Improving solution	Selection criteria 1	2	3	4	5	6	Total
Few employees	Enlarging the personnel scheme	3	3	3	3	3	3	18
	Unlocking vacancies under the law	2	3	2	3	2	2	14
	Additional performance award	1	2	2	2	2	3	12
	The use of motivational techniques	2	2	3	3	1	2	13
Failure to comply with legal requirements related to the number of samples	Adapting MS program each laboratory capacity	3	3	2	2	1	2	13
	Proposal for establishment plan for legislative change / laboratory	3	3	2	3	3	3	17
	Collaboration between laboratories where health network	2	3	2	1	1	2	11
	Collaboration with other laboratories outside the health network compatible	2	2	3	1	1	1	10
Obsolete equipment	renewal of equipment	3	2	3	2	2	3	15
	Reequipping the laboratory	3	3	3	2	2	3	16
	Stepping up the pace of testing and calibration	3	2	2	1	1	3	12
	Providing service of permanent	1	3	2	2	1	2	11
Non-performance of internal budget management	Redesign to optimize budget spending	3	3	3	2	3	3	17
	Assessment of the financial impact on the causes	2	3	3	1	2	2	13
	Setting a time to implement changes	2	2	2	3	2	1	12
	Precise clear methodology for eligible expenses from the Ministry of Health programs	3	2	3	1	3	3	15

To perform evaluations was necessary to elaborate some evaluation criteria such as:

- 1. the total cost;
- 2. the impact on the problem;
- 3. the cost / benefit;
- 4. resistance / impact to change;
- 5. implementation time;
- 6. uncertainty about the effectiveness.

To evaluate alternatives to improve in relation to these criteria the team used the following notations:

- 3 - very favorable impact;
- 2 - favorable environmental impact;
- 1 - poorly favorable impact.

After evaluating alternatives to improve the team determined corrective actions, resources and responsibilities and developed action plan presented in Table 4.

2.4 The control

At this stage the team has designed and implemented controls to ensure that corrective actions will be used and maintained.

All these elements are summarized in Table 5.

2.5 Multiplication results

The last step of the improvement project, and his team has the mission to ensure that real improvements are achieved successfully applied in other similar problems and establish new projects for continuous quality improvement in the organization about raising scheme staff and coverage of more samples to be tested that lead to conclusive results.

3 CONCLUDING REMARKS

In conclusion, the organization is an expression of Analyzing the average values and benchmarks that are in those periods analyzed (1995-2014), we find that there were higher values for both global alpha radioactivity and for global beta fish and potatoes in 1995-2004 and Milk higher values during 2005-2014 (figures 4-7).

The analysis values alpha radioactivity global food groups highlighted the following:

- For samples of milk, fish, and eggs, average values were greater than the average reference lately the decade 2005-2014, ie after 2010;
- The meat samples were recorded only two exceedances in 2005 and 2011;
- The best situation is to note where most potato samples were below the mean except in 2005;
- In all samples except for potatoes, the highest values were recorded in 2011.

As regards global beta radioactivity in food influenzas studied, it highlights the following:

- as global alpha radioactivity determinations in this case, the higher values of global beta radioactivity for milk, meat, potatoes, fruits and eggs were recorded in 2011.Excepţie fish which proves highest value It was recorded in 2005;
- note that 2011 is a year that all food groups alpha radioactivity have exceeded both global and global beta radioactivity, which concludes the results are influenced by the radioactive cloud from Fukushima (brought by rains and currents Air and dust-dust).

Analyzing the numerical and percentage number of samples with values above the limit is observed that both global alpha radioactivity measurements and for global beta were a larger number of samples above the limit value in fish, meat and milk.

Given the relatively large number of samples with values above the average, but also the fact that the total number of samples analyzed is lower than the established methodology, I appreciate the need to increase both the number of samples provided for additional methodology and in some cases that can be decided locally.

By increasing the number of samples were taken in several study areas and would be more conclusive results.

Reporting the results of which are classified as regulatory requirements will centralize and send to the coordinator of programs namely Timisoara Regional Public Health Center.

If the result does not correspond to the sample according to regulatory requirement, repeat the analysis of the sample and whether in this case, does not comply, it is necessary to prohibit eating by not issuing analysis report from suppliers.

I considered of interest trying to identify and assess existing problems in the organization.

By implementing improvement methodology, we sought to identify possible sources of nonconformities or opportunities for improvement of the quality of the laboratory.

Based on the findings, we have established a plan for improvement that the implementation may lead to solving cases identified.

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Table 4. Improving plan

No.	Causes	Correctiv action	Resources	Responsability	Term
1.	Few employees	Enlarging the personnel scheme	1 Human resources specialist	Head of HR	1 year
2.	Failure to comply with legal requirements related to the number of samples	Proposal for establishment plan for legislative change / laboratory	1 jurist	Director of Public Health Department	1 year
3.	Obsolete equipment	Reequippingthe laboratory	Material resources: igenizare space (100 m2), equipment,	Director of Public Health Department	1 year
4.	Non-performance of internal budget management	Redesign to optimize budget spending	laboratory furniture (lab table, cabinets, desks)	Head of Financial Accounting	1 year

Table 5. The control diagram

The variable	How to measure	Were	Reference	Who measures	Who decides	What does	Who checks	Frequency	Where records
Enlarging the personnel scheme	Checking duties of the job of every employee	Radiochemical Laboratory	Job description	Head of Laboratory	Executive Director	It has set tasks and checks planned	Executive Director	Yearly	Internal report
Proposal for establishment plan for legislative change / laboratory	Checking possibilities of the laboratory		Operational procedures	Chemist		It has possibilities verification the laboratory	Head of Laboratory		
Reequippingthe laboratory	Checking calibration certificates metrological bulletins and maintenances bulletins		Check Lists			It has reviewed the reports	Head of Laboratory		
Redesign to optimize budget spending	Checking the cost of purchasing the new equipment and employment of staff in dealing with their benefit	Sections within the facility: HR, procurement, and accounting	Documents for acquisition and staffing	Heads of departments		It has the paperwork to be approved by Ministry of Health	Deputy Director		

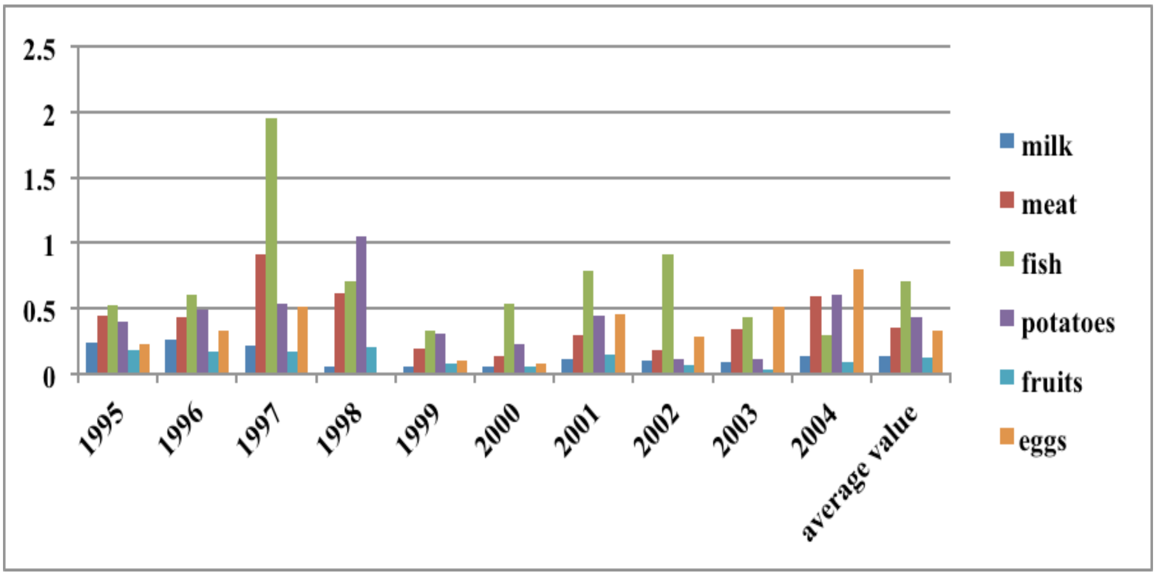

Figure 4. Global alpha radioactivity main food groups in 1995-2004 in Sibiu (Bq / l or Bq / kg)

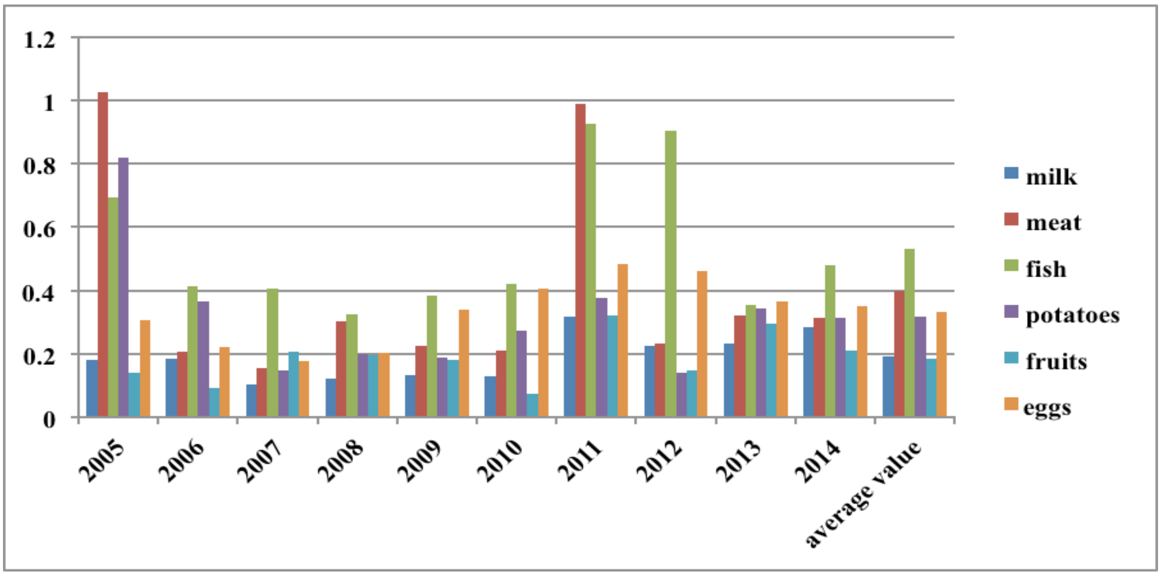

Figure 5. Global alpha radioactivity main food groups during 2005 to 2014 in Sibiu (Bq / l or Bq / kg)

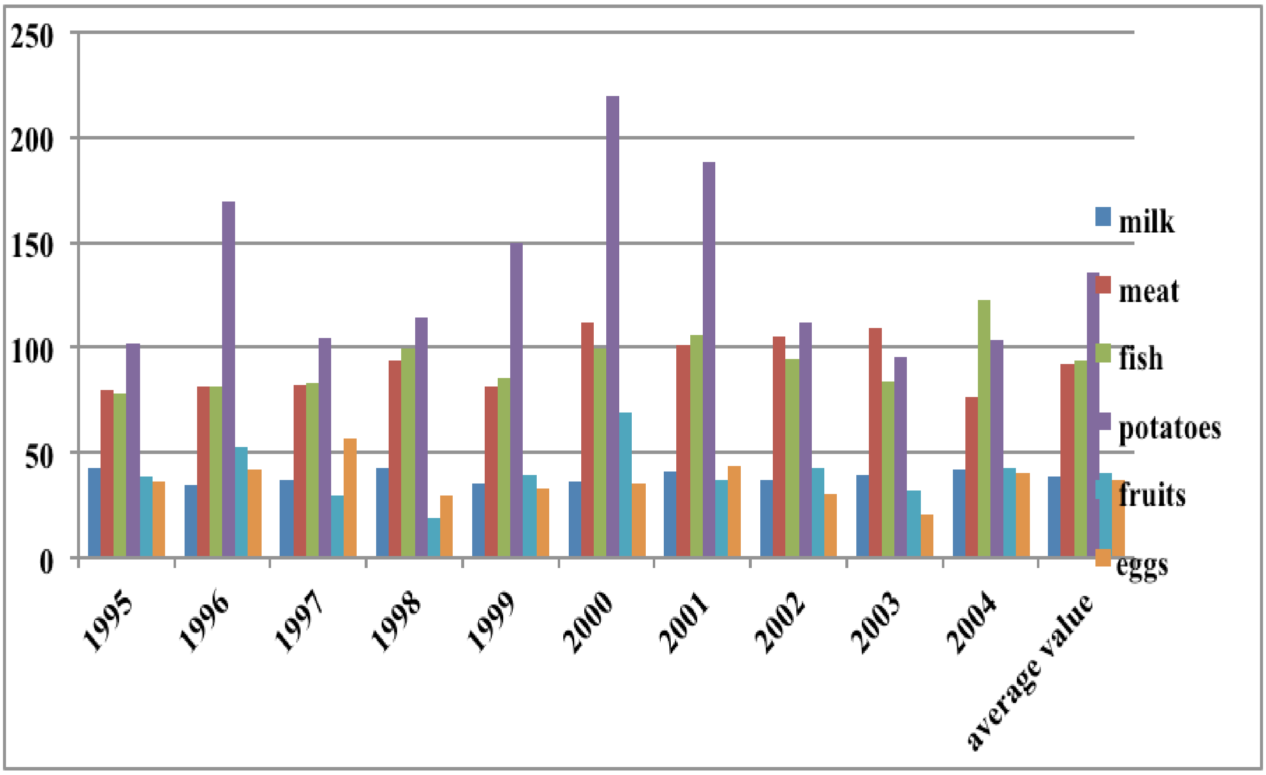

Figure 6. Global beta radioactivity main food groups in 1995-2004 from Sibiu (Bq / l or Bq / kg)

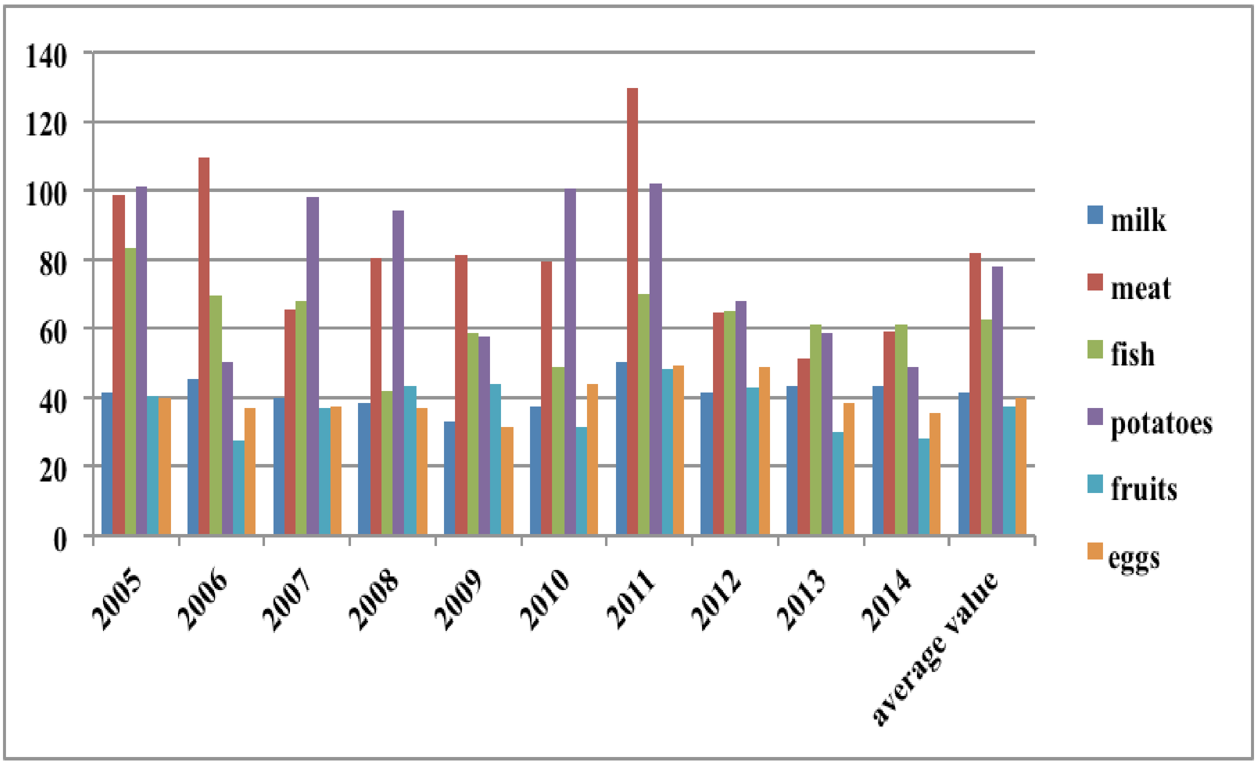

Figure 7. Global beta radioactivity main food groups during 2005 to 2014 in Sibiu (Bq / l or Bq / kg)