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THE CONSEQUENCES OF LEAD PETROL USE ON LEAD CONTENT IN CABBAGE ALONG THE MOTORWAY

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Abstract:
Besides the negative ecological consequences, during the production of the motor petrol (alkyl lead as anti–knock compound), as well as the application (combustion in motor engines), there are the ecological consequences manifested by deposition of Pb in the soil beside the motorway. At the same time this is the end of the life cycle of the petrol. However, Pb enters the human consumption chain through the plants that absorb Pb from the soil, and it is also deposited in the human body. The series of analyses of the cabbage head, outer leaves and soil includes left and right sides of the motorway of each of the control points, at the distance of 1m, 2m, 5m, 10m, 100m, and 400m from the motorway, each distance on the left and right side of the motorway. The results are shown in mg Pb/kg of the sample. The quantity of Pb shows decreasing effect when the distance from the motorway, is increased.

***Key words**: ecological consequences, lead content, soil, cabage production, Futog*

1. Introduction

Every product influences the environment to a certain extent during the course of its production, consumption and disposal at the waste dump. These influences can be weak or significant; short or long lasting ones; they can manifest on the global, regional or local level. Product standards regulations represent a significant factor in the scope of these influences on the environment[1, 2].

Some of the most important consequences of negative influences on the environment that appear during the course of production, as well as consumption are the following:

- greenhouse effect as the consequence of the enormous emission of carbon dioxide,
- endangered state of the ozone layer due to the hydrocarbon halogens,
- acid rains due to the increased level of sulfur monoxide,
- lead ingression into the human food chain due to the combustion of motor petrol,
- water ecosystem degradation due to the effusion of toxic and oily pollutants,
- inadequate employment of agricultural chemicals, medicinal drugs or other agents, etc.

The above-mentioned conceivable consequences are clear indicators of the fact that our irresponsible behavior towards nature leads to the extreme incertitude of human survival. Having violated the natural balance by employment of the powerful technologies and "in marketing terms interesting" (but ecologically dangerous) products, modern man finally realizes that something that was once the symbol of prosperity, nowadays marks the beginning of the destruction of the civilization.

In the chain of the "apocalyptic" pollutants, research processes, exploitation processes, as well as oil and oil derivatives production and employment ones have a significant and negative influence on the environment. This is especially the case with production and exploitation of motor petrol (lead alkyls as anti-knock component). Combustion in car engines marks the end of the life cycle of motor petrol as a product. However, it enters the food chain through plants that absorb lead from the soil the consequence of which is permanent depositing of motor petrol in human body. Thus, something that was once an essential part of the product becomes an almost unavoidable but dangerous food

ingredient. Since matter is indestructible ("dust to dust"), lead comes into the existence once again in such an unnatural way, but this time in living creatures (organisms). The emission of lead and its depositing in the soil along the motorway represents a direct and measurable ecological issue and it influences the environment (during the combustion of motor petrol besides other harmful and unhealthy emissions) to a great extent.

1.1 Utilization of motor (lead) petrols – influences and consequences of their utilization considering the environment

During the use (combustion in engines) of motor petrol, numerous carcinogenic and in other ways harmful compounds are produces. The emission of their content is especially conditioned by a valid motor petrol quality standard, an in our country it is JUS: b:H2.220/l dated from 1993. Changing the manufacturers' specifications, as well as accepting the more severe standards of motor petrol quality can reduce this negative influence on the environment. As this study has been focused on the indication and qualification of lead content in the soil, as well as on the environmental consequences (of lead additive employment as an ingredient in motor petrol), that implies that other ecological consequences will be merely mentioned in this study.

1.2 Consequences of lead – additives emission

Lead is considered to be one of the major nature pollutants, as well as the most important accidental intoxication factor among domestic animals. Lead and other heavy metals usually enter human and animal digestive tract through contaminated food and water. One of the most important aspects of water, soil and air pollution is combustion of motor petrol with lead-additives. The maximum degree of allowed concentrations (MDK/MAC) amount up to100 mg/kg for soil, and 0,1 mg/l for water (SL. R.S. 23/1994). Lead enters the food chain through plants. Therefore, in this study special consideration will be given to consequences that refer to plants. Plants take lead from the soil in the form of ions Pb^{2+} and/or organic compounds (TEL, TML).

The very mechanism of getting Pb from the soil has not been adequately explained yet and Pb organic compounds, especially their intermediary products, are fast and easily taken and moved to over-ground parts of plants. Greater accumulative ability of the root is considered to be an aspect of protection of the over-ground part of the plant from the increased level of Pb concentrations coming from outside.

The basic Pb toxicity mechanism represents mainly the influence on Ca metabolism and inhibition of numerous enzyme processes. In higher concentrations Pb inhibits root elongation, as well as leaf surface growth. It also inhibits photosynthesis intensity, transport of electrons in the process of oxidative phosphorilation and enzymes of the pentosophosphate cycle. Furthermore, Pb influences the necessary elements acquiring, morphological and anatomic structure of plants, especially leaves. Finally, it also influences the activity of nitrate-reductase enzymes [3,6].

Sensitivity of some of plant species to higher concentrations of Pb differs. Wheat and soybean, for example, have higher tolerance to Pb. This implies that wheat crop reduces significantly only in the case when the concentration of this element in dry straw matter reaches 45 mg/kg. Spinach falls into the group of plants that are sensitive to being exposed to higher Pb concentrations which leads to significantly lower crop yield even when Pb concentration is 10 mg/kg of dry matter. Tolerance metabolism of plants regarding excessive Pb has not been clarified yet and has often been related to metabolism of phosphor. It is assumed that plants are sensitive to Pb if insufficiently provided with phosphor. Otherwise, the most common portion of Pb in regular soils (neutral reaction) ranges between 0,1 – 20 ppm [6].

1.3 Lead contamination of arable land

Full attention is paid to lead due to the possible accumulation in the soil, especially along bigger traffic arteries from which it can get into human nutrition through food chain, plants and animals. Ubavić and his associates' research results have shown that lead content can vary to a great extent. These experts report concentrations range from 3,00 to 73,50 ppm in the testing soils. The average content regarding soils of Vojvodina amounted up to 17,17 ppm.

Novi Sad – Belgrade motorway, built in 1978, runs over arable land which leads to the conclusion that lead emission from motor engines represents the basic and probably only source of lead contamination of the soil. This conclusion was drawn from the fact that there was no other source of contamination (lead processing, sewerage silt manure, etc).

Soil sampling was performed in November 2000 at two locations in the area of Kovilj village, 20 km east of Novi Sad. Sampling was carried out at two points of the motorway (at 133rd kilometer and 3 km north of the bridge near Beška in wider region of the Special nature reserve "Kovilj marshland"), on the west side of the motorway at the intervals of 1, 2, 5, 10, 100, 400 m, and at 1, 30, 100, 400 m on the east side of the motorway. The analysis series also covers sampling at three different depths at the control points, from 0 – 10 cm, 10 – 20 cm and 20 – 30 cm for each interval on the left and right side of the motorway. Sampling at 2, 5 and 10 m on the east side was not possible to perform due to the construction of the second lane. Each sample amounted up to *1 kg* of the soil. The sample was prepared for the analysis after marking off the exact location at which it had been sampled.

2. Material and methods

Cabbage and soil samples were collected from both side of local road Futog – Begech on distances of 5, 10, 25, 50 and 100m. Soil was chernozem type.
Cabbage samples from each distance were separated on older, non-eatable outer leaves and head. Samples of cabbage outer leaves, head and soil were dried on 105°C and homogenized. Cabbage outer leaves and head were prepared with dry digestion method according to FAO (1980)[3] procedure, while Pb from soil samples were extracted with HNO_3 and H_2O_2 (EPA, 1996)[2]. Lead analysis was carried out with a flame Absorption spectrophotometer with background correction.

3. Results and discussion

Leads content in soil and cabbage outer leaves and head are presented in table 1.

Table 1. Lead content in soil, outer leaves and eatable part (head) sampled at the Futog – Begech road (mg/kg)

RIGHT SIDE			
Distance from road (m)	**Soil** (mg/kg)	**Outer leaves** (mg/kg)	**Head** (mg/kg)
5	11.79	1.64	<0.5
10	8.17	1.12	<0.5
25	<8.00	1.11	<0.5
50	<8.00	<1.00	<0.5
100	<8.00	<1.00	<0.5
LEFT SIDE			
Distance from road (m)	**Soil** (mg/kg)	**Outer leaves** (mg/kg)	**Head** (mg/kg)
5	11.28	1.38	<0.5
10	9.27	1.03	<0.5
25	<8.00	1.11	<0.5
50	<8.00	<1.00	<0.5
100	<8.00	<1.00	<0.5

Based on the research results it can be concluded that the distribution of potentially present Pb in the soil is of the highest degree (even above MDK/MAC) only along the motorway up to 2 km of distance from the road in the land surface stratum (up to 0,2 m deep). Distribution of lead in the soil decreases exponentially when moving away from the road (i.e. when the distance from the road increases). However, after a while the decreasing trend becomes almost even in case of greater distances regardless of the sampling depth and distance from the road. Meteorological conditions have far less influence on lead contamination in comparison with the above-mentioned conditions that can be seen from the results *(MDK/MAC is higher comparing to the limited value of up to 2 m).* Probable reason of such a result must be heavy specific gravity of lead. Terrain configuration (lowland-area, 76 m of height above sea-level) has not influenced the results significantly because the contaminants distribution is comparable from both sides of the motorway regardless of the minimal differences regarding the height above sea level (from 2 to 4 meters).

4. Final Remarks

Lead contamination of the soil on the testing location is solely a consequence of traffic (use of motor petrol), because there are no other sources of lead pollutants in the surrounding wide area (20 km). The cause of the presence of lead in the samples is construction of the motorway (1978) on arable land, as well as utilization of motor petrol with additives based on lead. Moreover, pollution/contamination can be considered as the consequence of traffic frequency and vehicle types (the ones using motor petrol with additives based on lead as fuel).

Bearing in mind the increasing trend in roads construction, as well as the rising traffic frequency along with out-of-date quality of motor pool, the negative influence of lead on the environment can be reduced only by changing the manufacturers' specifications, as well as adopting stricter motor petrol quality standards. This mostly involves the prohibition of employment of lead additives in motor petrol production. This is the only way to stop and prevent further pollution/contamination of arable land, as well as to reduce all of the post-consequences regarding the future generations. Voyvodina can become a significant food exporter due to its' natural resources (by way of realization of the "health safe food" production programme). Thus, previous irresponsible, and in every respect inadequate attitude towards nonrenewable natural resources must be stopped immediately. This is why we hope that this study and research will support such a decision.

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