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Study of Healthy Risks of Fertilizers on Biochemical Parameters in Workers

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Abstract: In order to evaluate the effects of the fertilizers NPK (nitrate, phosphate and potassium) toxicity, a study has been carried out on 34 workers of storage and distribution agricultural manures, exposed to phosphate and nitrate derivatives. The workers were divided into two groups according to age. Several biochemical parameters assay were measured. The results of assays are compared to standards and unexposed populations considered control. The results of biochemical parameters have shown not difference between control group and the exposed groups. Only, the results of biochemical parameters of TGP, creatinine reveals a significant increase and decrease of TGO in the two groups compared to the control.

Key words: Fertilizers · Healthy Worker · Risk

INTRODUCTION

Inorganic fertilizers consist mainly of salts of ammonium nitrate, phosphate and potassium [1], the combination of primary nutrients NPK including secondary and micronutrients nutrients are essential for plant growth, used for intensive agriculture, ranching and horticultural crops to increase soil fertility and ensure sustainable crop production [2, 3]. Nitrogen fertilizers are the main factor in agricultural areas [4]. Extensive use of nitrogen fertilizer causes high nitrogen uptake in plants, resulting a high content of nitrate in food and drinking water [5, 6]. The main sources of nitrates contaminating groundwater and surface water are fertilizers [7].

Between 1950 and 1998, the global use of fertilizers has increased more than 10 times and more globally four times per person. In 1998, 137 million tons of fertilizers were used in the world [8]. While in Algeria in 1999 used about 133 million tons after falling heavily from 1987 to 1998 and confirmed in 2000 to 155 million tons [9]. In 2010, chemical fertilizer use in Europe (EU-27) was as high as 10.4 Mt of nitrogen (N), 2.4 Mt of phosphate (P_2O_5) and 2.7 Mt of potash (K_2O). By 2019/2020, forecasters expect these fertilizer consumption figures to reach 10.8 Mt, 2.7 Mt and 3.2 Mt, respectively [10].

The manufacture of fertilizers is generally at a high temperature and high pressure, in the presence of several highly hazardous chemicals, dust and gases. These products are absorbed high in the airway [11].

Concerns regarding the health effects of occupational exposure to fertilizers have been raised by workers [12-14]. Tree planters have complained of skin rashes, nausea, headaches, nosebleeds, congestion, eye irritations and respiratory ailments when using powdered fertilizers [15, 14]. Exposure to fertilizer is most commonly associated with contact dermatitis [16] and occupational contact dermatitis has occurred in both industrial and agricultural settings. A case of severe contact dermatitis in fertilizer factory worker was attributed to sensitization from nickel and cadmium in the fertilizer dust [17]; a farmer's acute reaction was attributed to calcium ammonium nitrate in a urea fertilizer used in his field [18]. Allergic reactions may also cause respiratory issues, rhinitis, gastrointestinal illness and eye symptoms [16]. In 2003, a 14-year tree planting veteran suffered from skin rash, blisters, headaches, runny nose and eyes, facial swelling, dizziness, nausea and respiratory illness; symptoms he attributed to a new tea bag fertilizer. This individual eventually had a workers' compensation claim accepted on the basis that the worker's condition (sinusitis) was a result of tree planting employment [19].

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Several epidemiological studies have reported that occupational exposure to very high levels of nitrate in employees, resulting in a significant increase in body burdens of nitrate and nitrite in saliva [20]. No study has confirmed that the nitrate has a carcinogenic effect especially stomach cancer [21].

For an effective of prevention policy, it is necessary to limit the level and duration of exposure to harmful substances in workplaces [22].

So, extensive research conducted to date suggest that exposure to fertilizers not pose any major risk for employee health apart from primary pulmonary irritation before assigning some harmful effects to NPK fertilizers. The reason we were motivated to conduct this study to confirm the effect in workers after long-term exposure on biochemical parameters. In this context, the purpose of our work is the assessment of fertilizers handling risks in the workplace for workers.

MATERIALS AND METHODS

The study examined 34 workers aged 30 to 50 years. The control group was selected from an Analytical laboratory of males with the same age bracket (between 30 and 50 years) living mainly in non-industrial and non-agricultural region located in the other side of the Annaba city) and exercising trades of the school master or different administrative positions or unemployed.

Blood samples were taken from employers during the medical visit. Biochemical parameters of the assay was done by a automate (Ilab 300 Plus).

Statistical Analysis: Statistical analyses were performed by *t*-Student using Minitab (version 15). Data are expressed as means ± standard deviation (SD).

RESULTS

In this study, biochemical parameters were measured to assess the effects of exposure after fertilizers handling in NPK unit workers.

Effects of Fertilizers on Biochemical Parameters: The results obtained after the assay of plasma biochemical parameters in workers, summarized in Table (1), are all in the standards. However, a significant decrease of TGO, highly significant increase in the concentration of creatinine and a significant increase of TGP were noted in employees aged between 41-50 years compared to the control group.

DISCUSSION

We have shown that biochemical parameters were equivalent between the physiological norms and groups of workers exposed to mineral fertilizer NPK. These results are in agreement with the study of Boukerche [23] performed among workers in the same complex. Similar results were observed by Loukil [24] in the same unit on lipid parameters. This can be explained by a good medical management within the company, either by a development of organ system adaptive [23].

In studies with rats, daily doses of 200, 400 and 600 mg NH_4NO_3 per kg received *ad libitum* for a period of 3 weeks induced a proportional increase in serum glucose, an increased enzymatic activity of transaminases (GOT, GPT) and an increase of the urea and creatinin serum [23]. Batina [25] was found a disruption of liver enzyme system in rats in the presence of nitrate and nitrite.

An effect of nitrate in drinking water and food on biochemical parameters was observed only in animal experimental studies with much higher nitrate concentrations. However, extrapolation from these experimental animal studies to humans is not easy and comparisonbetween the studies is difficult because physiological inter-species differences, many designations of nitrate (potassium nitrate KNO_3, sodium nitrate $NaNO_3$ or nitrate ion NO_3^-) and different methods used to express [26].

Table 1: Determination of biochemical parameters in workers exposed according to their age (average ± standard deviation)

Parameters	30-40 n=14	41-50 n=20	Control n=34	Standard
Glucose (mmol/L)	5,361±0,821	6,194±3,363	5,361±0,355	4,163–6,383
GOT (UI/L)	18,29±2,58*	18,60±2,84*	19,70±1,57	5-40 UI/L
GPT (UI/L)	19,21±9,00*	21,15±7,28*	16,30±4,95	5-35 UI/L
Urea (mmol/L)	5,428±1,116	4,779±0,833	4,063±1,265	2,498–7,493
Creatinin (imol/L)	88,667±13,791**	90,966±17,238**	72,313±9,194	61,881–123,763

* (P < 0,05); ** (P < 0,01); *** (P < 0,001): significant difference from the control group.

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