Nitrate Situation in Some Vegetables and the Necessity of Crop Production via Organic Farming

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Abstract
Nitrate is potentially harmful regardless of the source. Commonly, vegetables are considered as one of the resources causing the nitrate to enter the body. The object of this research was to determine the amounts of nitrate in cucumber, carrot, lettuce, tomato and potato in the greengroceries at southwest region in Shiraz city (South of Iran). Samples were collected from seven different places in April, May and June 2008. After the sample preparation, the amounts of nitrate were measured. Finally, the concentration of nitrate in samples was compared with the World Health Organization (WHO) standards. The results showed that the amounts of nitrate in many of sampled vegetables are higher than accepted standards. April is a critical time for nitrate accumulation in harvested vegetables. Cucumber, potato and tomato had much more nitrate than the standards. It can be concluded that for healthy crop production a move to organic farming is a necessity for governments and farmers.

Key Words
Vegetables, Nitrate Levels, Biofertilizers, Shiraz.

Introduction

Globally, human nitrogen production has increased rapidly since 1950 and currently exceeds nitrogen fixed by natural sources by about 30% (Fields 2004). Nitrogen is the nutrient applied in the largest quantities for lawn and garden care and crop production. Fertilizer is the largest contributor to anthropogenic nitrogen worldwide. In addition to fertilizer, nitrogen occurs naturally in the soil in organic forms from decaying plant and animal residues.

Nitrate is essentially harmless. However, certain kinds of bacteria in the digestive tract change the nitrate into nitrite, a much more harmful substance. Human exposure to nitrates and nitrites results primarily from dietary ingestion, particularly from vegetables and cured meats.

A potential cancer risk from nitrate (and nitrite) in water and food has been reported. A study in humans showed that nitrate in vegetable matrices and from other sources, such as drinking-water, is almost totally bioavailable. The bioavailability of nitrate from spinach, lettuce and beetroot was high and not significantly different from that of nitrate in drinking-water (Lambers *et al*. 2000). After ingestion, nitrate is readily absorbed from the upper gastrointestinal tract. Up to 25% is actively excreted in saliva, where about 20% is converted to nitrite by bacteria in the mouth (Spiegelhalter *et al*. 1976). This conversion can occur at other sites including the distal small intestine and the colon.

A possibility exists that nitrate can react with amines or amides in the body to form nitrosamine which is known to cause cancer. Nitrate must be converted to nitrite before nitrosamine can be formed.
When nitrate levels in drinking water are below the current regulatory standard, the large majority of individual's nitrate intake is from vegetables rather than water (ECETOC 1988). The half-life of nitrate in the body is over 8 hours, which means that after a meal containing spinach, lettuce or another source of nitrate, the levels in the blood will be elevated for about 40 hours (McKnight *et al.* 1997).
The aims of this investigation were study of the nitrate levels in supplied vegetable crops in some stores and comparisons of obtained data with standards.

Methods
This investigation carried out with vegetables including cucumber, carrot, lettuce, tomato and potato in southwest of Shiraz city (South of Iran). Samples were collected in three times (April, May and June 2008) from seven greengrocery stores. After washing with tap water and distilled water, moisture contents of samples were determined at 60 °C. Dried samples were powdered with grinder and 0.5gr of powdered samples were poured in 50ml of distilled water mixed and shake for 30 minutes. The mixture was filtered by paper filter. Then 0.1gr of MgO and 0.1gr of Devardo Alloy added to 5ml of filtered extract and shake for 30 minutes. Eventually, the amounts of nitrate were measured by Kjeldahl method. The total means of obtained data for each vegetable were compared with World Health Organization standards (WHO 1976).

Results
The means of nitrate content in vegetables shown in table 1 for three events. Data shown in column 2, 3 and 4 are the means of 7 measurements and data shown in column 5 are the means of 21 measurements.

Table 1. The means of nitrate in different vegetables (mg/kg of fresh weight).

Vegetable	April 2008	May 2008	June 2008	Total mean	WHO standard
Cucumber	1021	794	203	673	150
Carrot	539	454	99	364	415
Lettuce	1873	804	637	1105	2001
Tomato	1272	799	754	942	300
Potato	1091	702	178	657	250

The whole of sampled vegetables except lettuce contain nitrate higher than WHO standards in April and May, but in June, only cucumber and tomato had higher nitrates than WHO standards.

According to table 1, it is obvious that the amounts of nitrate in many of sampled vegetables are higher than accepted standards. For example, the nitrate content in cucumber was 1021 mg/Kg in April. This shows the nitrate content in cucumber was 5.8 times higher than standard (WHO 1976). The same calculations for potato and tomato show 3.4 and 3.2 times compared to standards. The amounts of nitrate in studied vegetables decreased with time. It seems that April is a critical time for producers and consumers. Total mean comparisons show that almost sampled vegetables (except lettuce) have nitrate higher than standards. Vegetables are the major source of the daily intake of nitrate by human beings, supplying about 72–94% of the total intake. Part of this nitrate-N is converted to nitrite and N-nitroso compounds that have detrimental effects on human health (Gupta *et al*. 2008).
Some vegetable species such as lettuce, spinach, beetroot, celery, eggplant, beet, banana, strawberry, tomatoes and peas are known to accumulate high concentration of nitrate under heavy fertilization (Gupta *et al*. 2008). Being a rich source of nutrients and antioxidants, leafy vegetables occupy an important place in the human diet. However, attention should be paid to fertilization managements. Probably, abuse application of nitrogen fertilizers i.e. use of higher amounts of urea than the needs of plants is responsible for this crisis. It is suggested that remove of chemical fertilizers subsides and obligate the farmers for soil testing. Nitrate fertilizer applied shortly before harvest causes the greatest increase in nitrate levels and should be avoided. In addition, lack of precision in harvest time can be as the second factors. Attention to organic farming via application of green manures, animal manures, composts, biofertilizers and conservation tillage could be mitigating the present problems.

Conclusion
Management practices such as proper fertilizer application follow the soil testing and deleting the chemical fertilizers subsides and use of organic materials and biofertilizers to reduce the risk of nitrate accumulation help keep the produced crops safe.

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