A PRELIMINARY SURVEY OF THE PUBLIC ACCEPTANCE OF THE USE OF HUMAN URINE AS FERTILIZER IN TURKEY

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INTRODUCTION

Ecological Sanitation (ECOSAN) is a new sanitation concept which claims that domestic wastewater is not a waste to be discarded but a source to be revaluated. The new concept recommends separate collection of domestic wastewater fractions at the source and their further use as appropriate. One of those fractions is yellow water, i.e. source separated human urine, which contains the largest portion of nutrients by far. The final use of yellow water as fertilizer is suggested by the ECOSAN approach.

Over 80% of nitrogen together with 50% of both potassium and phosphorous in conventional domestic wastewater comes from urine. It is reported that the nutrients in human excreta from one adult is sufficient for providing 80% of nitrogen and almost all of potassium (100%) and phosphorous (90%) for the production of the annual cereal needed per capita (Wach, 2007). Of this, 89% of N, 76% of K, 67% of P come from urine. This makes the use of human urine a viable alternative as fertilizer for agricultural and landscape purposes. The great majority of pathogens remain in feces however, a small number may also be associated with urine. A storage period of up to six months is recommended for bacteriological safety before application onto soil (Hoglund et al., 2002; WHO, 2006). In addition to bacterial degradation during storage, urea which is the predominant form of nitrogen in fresh urine is converted into ammonical nitrogen (Udert 2003; Beler Baykal & Bayram, 2007; Beler Baykal et al., 2010).The fate of hormones and pharmaceuticals in urine are yet to be investigated.

Human urine may be applied onto plants though direct or indirect routes. When applied directly, all constituents in urine are bound to come to contact with plants. This includes salinity, an attribute which is not desirable for plant growth. If direct application is selected, dilution should be exercised prior to application which will reduce the negative impact due to salinity. Indirect application on the other hand, considers concentration of nutrients specifically in a new phase which will be separated out from urine thereby leaving the undesirable components in the original urine solution, and follows some kind of processing.

A number of papers related to human urine within this context have appeared in literature in 2000's reporting results from various research work and actual applications. The majority of those are concerned with the direct use of urine on agricultural fields (Jonsson, 2004; Pinsem et al., 2004; Simons & Clemens, 2004; ...).

Although smaller in number, several pieces of work are devoted to the indirect use of urine in literature, which employ methods like struvite precipitation, freeze-thawing and ion exchange. Struvite precipitation was reported to be especially effective for phosphorous recovery with a minimum of 90% (Harada et al., 2006; Kabdasli et al., 2006). Ganrot et al. (2007, 2008) applied urine as fertilizer after freezing-thawing and struvite precipitation and/or adsorption to zeolite and reported 97% phosphorous and 90% nitrogen recovery. Beler Baykal et al. (2004, 2009) used ion exchange with clinoptilolite for transferring the ammonium and potassium from stored urine onto the solid phase and achieved 97% ammonium and 99% potassium removal. Total recovery of ammonium from exhausted clinoptilolite under conditions mimicking irrigation was reported as 88% (Beler Baykal et al., 2010).

Using source separated human urine as fertilizer is a promising alternative which will lead to sustainability however, public acceptance plays a prime role in actual application. A survey undertaken in Switzerland had shown that farmers accepted the use of urine as fertilizer as a good/very good idea with 57% and bad idea with 33% for 125 participating farmers (Lienert et al., 2003). In other Swiss survey, 72% of consumers thought they would eat vegetables fertilized with urine, and 80% of participants had a preference for vegetables fertilized with urine over artificial fertilizer (Pahl-Wosti et al., 2003). However, participants indicated concerns about micropollutants, hygienic aspects, residues such as hormones and pharmaceuticals.

The aim of this study was to make a preliminary survey in attempt to assess the attitude a group of Turkish people towards approval and willingness to use plants fertilized with direct and indirect use of human urine. Participating individuals, who were residents of Istanbul, were asked for their opinion to enable comparisons between natural fertilizers versus artificial fertilizers; acceptance of urine as fertilizer versus willingness to consume those plants; direct use versus indirect use; and acceptance of application on three different groups of plants.

METHODS

The questionnaire was aimed at finding out public attitude towards the utilization of urine as fertilizer for agricultural or landscape purposes. About 100 people were asked to fill in the questionnaire. Of those who responded, 51% were males with an average age of 34 and 49% were females with an average age of 35.

In addition to personal data like age, gender, education, occupation, residence etc., the participants were asked to share their ideas regarding

i) Acceptance of fertilizers in agriculture (natural or artificial)
ii) Approval of using urine directly as fertilizer for specified products
iii) Willingness to consume specified products that were fertilized directly with urine
iv) Approval of using processed urine as fertilizer for specified products (i.e. indirect use)

v) Willingness to consume specified products that were fertilized with processed urine (i.e. indirect use)

Three groups of plants were questioned: landscape plants, plants eaten raw, and plants eaten cooked.

RESULTS AND DISCUSSION

The results of the survey are presented in Table 1 in the appendix and Figure 1. 100% of the participating individuals indicated that they would accept the use of natural fertilizers while less than half, only 49%, approved of the use of artificial fertilizers. A survey of Figure 1 indicates that the acceptance and willingness to use plants fertilized through indirect use of urine was higher as compared to direct use. This was true for all three groups of plants questioned. The gap between direct and indirect use was less pronounced for landscape use as compared to plants which are eaten either raw or cooked. The approval and willingness for consumption was highest for landscape plants and lowest for plants which are consumed raw. Landscape plants received an approval and willingness to consume at relatively higher levels, over 50% for direct use and over 80% for indirect use. Less than one third of the participating individuals accepted direct fertilization

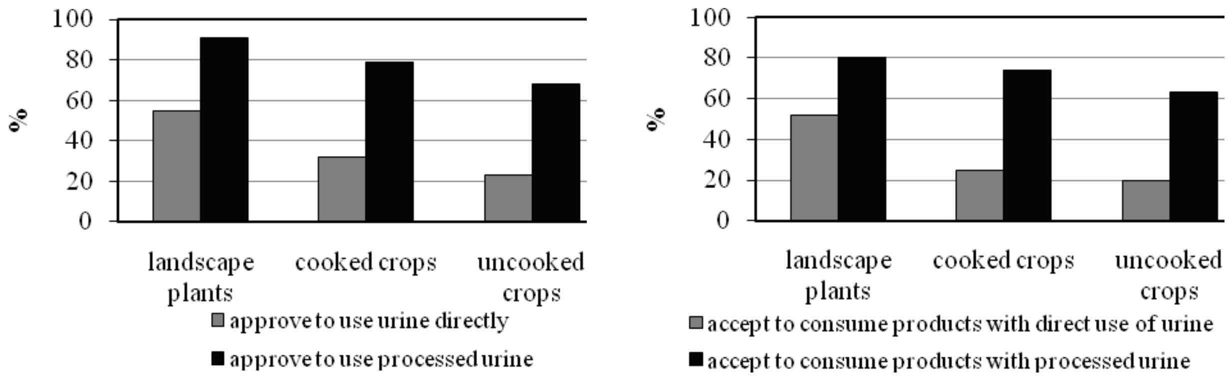

Figure 1. Attitude of participating individuals towards the use of human urine as fertilizer

of plants to be eaten with human urine, while the ratio rose to over two thirds via the indirect route. A comparison of the approval of the use and willingness for self consumption shows that not all which approve the use of urine are ready to consume plants fertilized with urine.

The participants who indicated concern were uncomfortable about the idea of using urine and had uncertainties about the reliability of utilization. The main reasons of concern were the human health aspects, especially pathogens, and the safe use of urine as a fertilizer. In all age groups or educational levels the concerns were similar. No major differences were observed with gender.

CONCLUSIONS

Attitude of consumers towards the use of different types of fertilizers and the possible use of source separated human urine is one of the priority determinants for their large scale and widespread application. The results based on the response of participating individuals of the preliminary survey had revealed that the acceptance for natural fertilizers was 100% while only about half thought artificial fertilizers are acceptable. There was a considerably higher acceptance for indirect use of human urine as fertilizer after some kind of processing. Landscape plants received a much higher acceptance as compared to food stuff to be eaten by consumers. The use of human urine was more acceptable for plants eaten cooked as compared to those eaten raw. Self consumption of plants fertilized with human urine received a relatively lower acceptance than approval of the use of fertilizers. Positive results to be obtained from further research on the fate of human urine as fertilizer will probably lead to the revaluation of this "resource" and bring it closer to the acceptance of natural fertilizer which is basically animal excreta.

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APPENDIX

Table 1. The percentages of acceptance according to age, gender and education level

SECTIONS		Age			Gender		Education		
		20-30	30-45	>45	M	F	Primary	High	Uni
	N	36	15	14	33	32	11	10	44
	Total %	55%	23%	22%	51%	49%	17%	15%	68%
Approval of using fertilizer in agriculture									
Natural Fertilizer	**100**	100%	100%	100%	100%	100%	100%	100%	100%
Artificial Fertilizer	**49**	50%	59%	42%	48%	50%	36%	50%	48%
Approval of using urine directly for									
A. Plants for landscape	**55**	61%	47%	50%	57%	53%	45%	30%	64%
B. Cooked crops	**32**	33%	27%	36%	27%	25%	27%	10%	39%
C. Uncooked crops	**23**	22%	13%	35%	21%	25%	27%	10%	25%
Consuming products with direct use of urine									
A. Plants for landscape	**52**	61%	47%	28%	54%	47%	45%	30%	61%
B. Cooked crops	**25**	30%	13%	24%	24%	25%	18%	10%	29%
C. Uncooked crops	**20**	22%	13%	21%	18%	22%	18%	10%	23%
Approval of using processed urine for									
A. Plants for landscape	**91**	92%	87%	93%	86%	94%	91%	80%	93%
B. Cooked crops	**79**	77%	73%	93%	67%	91%	91%	60%	82%
C. Uncooked crops	**68**	64%	60%	85%	61%	75%	82%	60%	66%
Consuming products with processed urine									
A. Plants for landscape	**80**	78%	80%	86%	76%	91%	82%	70%	86%
B. Cooked crops	**74**	75%	67%	78%	64%	81%	73%	50%	82%
C. Uncooked crops	**63**	61%	53%	78%	61%	63%	73%	50%	64%
Concerns and remarks									
Wrote additional remarks	**18**	14%	27%	21%	21%	16%	18%	20%	14%