Gainutri™ today

1) Hygienic aspects

The fertiliser Gainutri™ analysed here, contains only nutrients from urine collected with urine separating toilets at Ekocentrum and has no fecal matter contamination. Ekocentrum, Scandinavia's largest eco exhibition place - has only urine separating toilets (www.ekocentrum.se/en). Gainutri™ is air-dried and totally odor-free. The analysis results from air-dried Gainutri™ made from Ekocentrum urine (Table 1) shows that it is hygienic [1].

Analysis type	Result Urine	Result for Gainutri™	Unit
Salmonella	Not fund	Not fund	/25g
Enterococchi	< 100	< 100	cfu/g
Escherichia coli	< 10	< 10	cfu/g

Table1. Bacterial analysis on urine and Gainutri™ performed by Eurofins (accredited lab) on duplicates from urine and air-dried Gainutri™ (same batch).

This result means that Gainutri™ can be classified as hygienic regarding these common bacteria, even within the limits for tap water in Sweden [1].

2) Pharmaceutical residues, etc.

An excerpt from the analysis results for pharmaceutical- and hormone residues performed by Eurofins accredited laboratorium is presented in Table 2 below (the whole report can be obtained on request from Again). The analysis itself comprises 85 types of residues. The analysis was performed on urine and on the remaining liquid (the process liquid after the Gainutri™ production). From the urine itself and the remaining liquid one can calculate how much of pharmaceutical- and hormone residues will be retrieved (taken up) in the Gainutri™ itself (expressed in %). Here in our table below are presented all the 27 types of residues found in urine and in the remaining liquid (some residues were very close to the detection limit and these are symbolised with "< "in the table). In the last column (on the right) is presented the calculated share (in %) for the residues in the Gainutri™ .

PLEASE NOTE! *The amounts are not saying anything about possible dangers, environmental impacts (especially in soils), plant availability, etc., of these residues! There are no discharge limits for these residues to recipients (nor aquatic or terrestrial) today. There are no purification requirements either (with discharge limits) for these residues for our treatment plants, etc., either.*

However, the paramount importance of the soil environment regarding the fate of these unwanted residues is well documented for example in a Swedish summary-report over many scientific experiments and longtime studies. Here the soil environment is described as an environment where pharmaceutical and hormone residues are effectively "rendered" and the "break down effect" of soil microorganisms is preferable to the ones in aquatic environments [2].

Residue type	In urine (ng/l)	In remaining liquid (ng/l)	In Gainutri™ (%)
Amlodipin	300	64	79
Atenolol	32000	6500	80

Cetirizine	4600	370	92
Citalopram	1700	< 1000	-
Diklofenak	18000	14000	22
Enalapril	6200	6000	3
Fluoxetin	370	<40	-
Furosemid	4700	4300	9
Hydroklortiazid	13000	2000	85
Ibuprofen	350000	330000	6
Ipratropium	100	<40	-
Ketoprofen	10000	10000	0
Kodein	360	110	60
Losartan	17000	9000	47
Metoprolol	5000	830	83
Mirtazapin	4600	61	99
Naproxen	3300000	2700000	18
Paracetamol	1100000	980000	11
Renitidin	340	<40	-
Salbutamol	68	<40	-
Sulfametoxazol	340	120	65
Tetracyklin	8400	<2000	-
Tramadol	7200	820	89
Warfarin	130	96	26
Xylometazolin	92	<40	-
Östriol	2500	1400	44
Östron	2100	170	92

Table 2. The analysis results of pharmaceutical and hormone residues in urine, in remaining liquid and the calculated share of them (in %) Gainutri™ (ng/l means nanogram per liter).

The Swedish report also says [2]: ”One cubic meter soil contains approx. the same amount of microorganisms as one cubic kilometer water, which means that most of pharmaceutical- and hormone residues will be bracken down much more effectively in soils than in water. Because urine and fecal matter is molded into the upper, active layer of the soil, the residues will be affected by this intense break down processes. The risk that pharmaceutical- and hormone residues will impact on the quantity and quality of the cultivated crops in the soil is considered to be marginal when urine of fecal matter are used as fertilisers.”

The same results have shown even in a recently made agricultural longtime experiment in Skåne (southern Sweden) where biogas sludge from a municipal wastewater treatment plant was used [3].

These conclusions also indicate that this may be applied for our Gainutri™ as well, being a product from urine and with much lower content of certain pharmaceutical residues than urine.

The analysis result indicates for examle that the most of the problematic form of the synthetic estrogen, etinylestradiol, is under the detection limit in our case: in urine and remaining liquid as well as in Gainutri™ itself. The most commonly used anti-inflammatory pharmaceuticals (see those over 10 000 nanogram/l in the Table 2) are present only in a very low share in the Gainutri™; only 6 - 22%. Such a "high purification grade" is only a future goal for most of the municipal treatment plants which are testing "state-of-the-art"-methods like ozone or enzyme based treatments today [4,5]. The most modern treatment plants in Sweden (and worldwide) can as best "remove" 50-60 % of the most common pharmaceutical- and hormone residues. Many common pharmaceuticals are not removed at all. Other types, like antibiotics and anti-depressives, are very difficult to "get rid of" no matter the method used. [4,5]. Moreover, some of the new methods, like ozone treatment, usually produce more dangerous byproducts then the residues themselves were.

With Again´s technology the majority of the pharmaceutical- and hormone residues will end up in the remaining liquid (process liquid) and will be treated onsite in soil based step (soil bad) or sent directly to the nearest municipal wastewater treatment plant.

3) Nutrients and metals

The requirement to capture and reuse the nutrients from society and to more effectively household with scarce natural resources — especially phosphorus, but even nitrogen- is steadily increasing nowadays. We already know that the most nutrient rich flow in a household wastewater stream is coming from the toilets, especially from urine [6,7]. It is also well known that all type of components, nutrients as well as unwanted ones, are very easily available from urine itself as a liquid fertiliser, and this is not only positive.

1 kg Gainutri™ is made from 4 liter urine and the main component in our additive (and consequently in the Gainutri™ also) is a natural zeolite.

Analysis type	**Result urine**	**Result for 4 liter urine**	**Result Gainutri™**
Dry Matter(DM)	-	-	93,3
pH	8,8	8,9	8,6
CaO-effect	-	-	0,052 -1,8
Macro and micro nutrients			
N (Kjeldahl)	-	-	2 650
NH_4-N	865	3384	2 300
NO_3-N	<0,10	<0,10	-
Ca	26	104	24 500
K	315	1 260	16 000
Mg	< 50	< 50	7 600

S	34	136	1 300
P	42	168	340
Cu	< 0,02	< 0,02	4,3
Ni	< 0,02	< 0,02	9,5
Zn	< 0,1	< 0,1	39
Unwanted metals*			
Cd	< 0,02	< 0,02	0,08
Pb	< 0,005	< 0,005	52
Hg	< 0,0001	< 0,0001	< 0,048
Cr	< 0,02	< 0,02	4,0
* measurement uncertainty 25%			
NOTE that some nutrients are much higher in Gainutri compared to urine, e.g. Ca, K, Mg, S. This because the natural zeolite used in our additive contains already high amounts of these.			

Table 3. Mineral nutrients and unwanted metals in urine, zeolite and Gainutri™. The analysis were made on duplicates and performed by Eurofins accredited lab (detection limits are symbolised with "< "in the table).

We can consider Gainutri™ more as a *nutrient enriched soil conditioner* because of its high zeolite content. Natural zeolites are wellknown and commonly used as substrates in greenhouse cultivations or in outdoor cultivations all over the world. *Zeo-agriculture* is a large research area for more than 50 years. Zeolites are professionally used in agriculture for more than 80 years. The literature in this area is very abundant and here we are referring to two comprehensive articles [8,9] and the latest handbook in this field [10], all in English.

Please note: Gainutri™ is not a full mineral fertiliser regarding to the phosphorus and nitrogen content and therefore needs a complementary fertilising when used in agriculture.

References (most Swedish) used:

[1] Gränsvärden och tolkning av hygieniska analyser http://livsmedelsanalys.alcontrol.se/gransvarden

[2] Hjelmqvist J, m fl, (2012) Återföring av näring från små avlopp. En kunskapssammanställning om källsorterande avloppssystem för enskilda hus och samlad bebyggelse. CIT Urban Water Rapport 2012:1 http://urbanwater.se/sites/default/files/filer/aterforing_av_naring_fran_sma_avlopp_-_urban_water_2012.pdf

[3] Läkemedelsrester i avloppsvatten och slam (2011). Broschyr utgiven av Region Skåne, Lunds Universitet och Kommunförbundet Skåne: Om odlingstester - se sid 5. https://www.skane.se/Upload/Webbplatser/Skaneportalen-extern/dokument/A5_6sid_l%C3%A4kemed.pdf

[4] Artikel om ozonteknik:
http://www.nyteknik.se/nyheter/bioteknik_lakemedel/lakemedel/article3939570.ece

[5] Om ozonteknik: http://www.tidningencurie.se/22/nyheter/nyheter/2014-09-09-ny-teknik-renar-vatten-fran-lakemedel.html

[6] Håkan Jönsson, m fl, Fakta Jordbruk: Samhällets organiska avfall - en resurs i kretsloppet. http://www.slu.se/Documents/externwebben/overgripande-slu-dokument/popvet-dok/faktajordbruk/pdf03/Jo03-01_02.pdf

[7] Helena Almquist, m fl, (2007): Sammansättning av flöden på BDT-vatten, urin, fekalier och organiskt avfall i Grebers. Svensk Vatten Utveckling, Rapport 2007-05.
http://vav.griffel.net/filer/Rapport_2007-05.pdf

[8] Daniel FritzHenry, a Literature Review. http://www.plantnet.net.au/resources/ZEOLITE-Research.pdf Senast sökt: 2016-04-04

[9] Mumpton, F A, (1998): La roca magica: Uses of natural zeolites in agriculture and industry. PNAS of US, vol 96 no 7, 3463-3470. http://www.pnas.org/content/96/7/3463.full

[10] Inglezakis V and Zorpas A (eds) (2012): Handbook of Natural Zeolites, Bentham Publ, ISBN: 978-1-60805-446-6. http://www.eurekaselect.com/101819