

General:

- * Urine consists mainly of protein and nucleotide breakdown products
→ rich in nitrogen [1]

kg / ppa	N	P	K	C _{org}	Masse _{frisch}	Masse _{trocken}
Urin	4	0,4	0,9	2,4	440	22
Fäzes	0,6	0,2	0,4	7,8	25-50	12,8
Fäkalien	4,6	0,6	1,3	10,2		

source: S.A. Esrey et al, 2001 [9]

- * Amount of human excretion: 90% urine
- * Approximately 80% of the excreted nutrients are found in urine
- * Occurring amounts per person per year: an average of 500 L (~9,6L/week*pp
→ 1-1,5 L/day*pp)
- * The nitrogen content can be estimated at about 3 to 7g of nitrogen per liter of urine

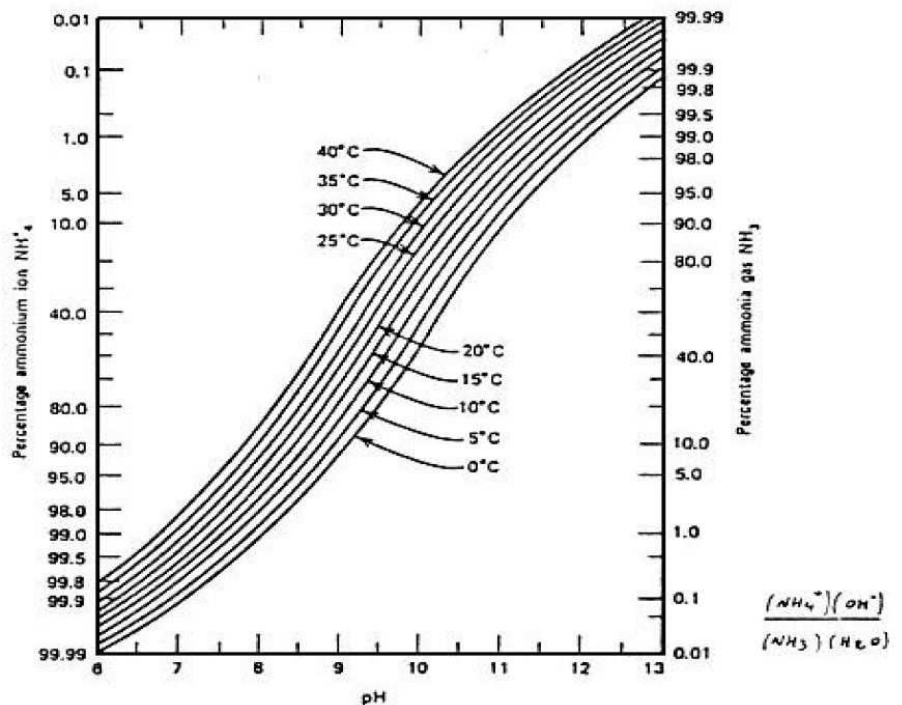
Hygienic:

- * During its formation in the kidneys and its storage in the bladder, urine of a healthy person is sterile. However, urine excreted urine contains up to 10,000 germs per milliliter since the lower urethra is not sterile. [1]
- * Except in the case of faecal cross-contamination, the urine of a healthy person does not pose a hygienic risk to subsequent use. [4, 5]

* During storage, urea is enzymatically (urease) converted into ammonia (NH₃) and carbon dioxide. Thus the initial mostly neutral to acidic urine, becomes basic (pH about 9 to 9.2). [1]

In this case an equilibrium is established between ammonium (NH₄⁺) and NH₃.

source: distribution of ammonia and ammonium in respect to pH and temperature [10]



* According to previous studies, a greatest possible hygienisation can be achieved by long storage times [in a tightly closed container] (about 6 months, over 20 °C, undiluted). [2, 3, 5]

Application as fertilizer:

* Due to the high pH of urine, it is to be diluted (with 4 to 10L of water per L urine) before application to the soil (not directly on the plants!). [8]

* An initial fertilization should be made only after germination (germ-inhibiting effect). [11]

* One month should elapse between the last fertilization [urine] and harvesting. [5]

* Urine should be entered directly into the soil or be applied and incorporated in order to avoid aerosol formation. [5]

* Fertilization should be done according to local recommendations (from agriculture). Rule of thumb is that one day urine of one person is enough for 1m² of land per season. [7]

→ In using only stored urine in agriculture, the organic components mainly included in urine are applied to soil. [6]

Sources:

[1] wikipedia.org, "urine" , accessed on 27 April 2014.

[2] Susann von Wolffersdorff, 2004, Untersuchungen zu Sortiertoiletten unter besonderer Berücksichtigung der Urinverwertung. (Studies on sorting toilets with special consideration of the urine recovery).

[3] Maurer et al., 2006; World Health Organization, 2006; Vinnerås et al., 2008).

[4] Michael Yongha Boh, Jörn Germer, Torsten Müller and Joachim Sauerborn, "Comparative effect of human urine and ammonium nitrate application on maize (*Zea mays* L.) grown under various salt (NaCl) concentrations", 2013, J. for Plant Nutrition and Soil Science, 176, 703–71).

[5] Caroline Schönning, Thor Axel Stenström, "Guideline for the safe use of Urine and Faeces in Ecological Sanitation Systems", 2004, Swedish Institute for Infectious Disease Control, EcoSanRes Programme.

[6] A.Bastian et al, 2005, Nährstofftrennung und -verwertung in der Abwassertechnik am Beispiel der „Lambertsmühle“. (nutrient separation and recovery in waste water technology on the example of "Lambertsmühle").

[7] Jönsson, H. et al. 2004. Guidelines on the Use of Urine and Faeces in Crop Production. EcoSanRes Publication Series. Report 2004-2. Stockholm Environment Institute; Stockholm, Sweden. Available from www.ecosanres.org

[8] Thor Axel Stenström, Razak Seidu, Nelson Ekane, and Christian Zurbrügg "Microbial Exposure and Health Assessments in Sanitation Technologies and Systems " EcoSanRes Programme , Stockholm Environment Institute , Stockholm, 2011. Available from www.ecosanres.org

[9] [1] S.A. Esrey, I. Andersson, A. Hillers, R. Sawyer. "Closing the Loop - Ecological sanitation for food security." Technical report, Swedish International Development Cooperation Agency, Mexico, 2001.

[10] Food and Agriculture Organization of the United Nation, 2012.

<http://www.fao.org/docrep/field/007/af012e/AF012E02.htm> [accessed 17 July 2012]

[11] Lisa Häfner, Wachstum und Nährstoffversorgung von Spinat auf verschiedenen hergestellten "Terra-Preta-Komposten" (growth and nutrient supply of spinach on different produced "Terra Preta composts"), Bachelorthesis, TU Berlin, 2012.