# Kjeldahl Analysis for Nitrogen and Protein

SAMPLE

RESULT
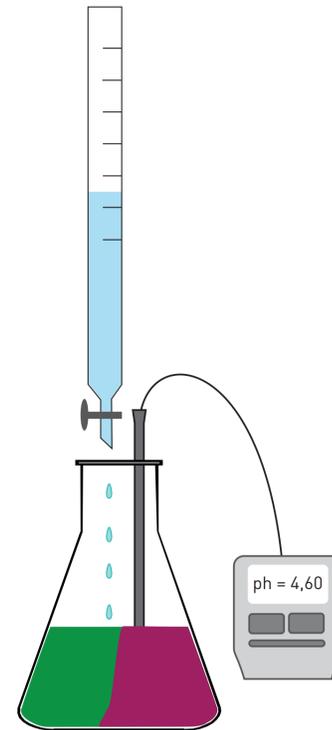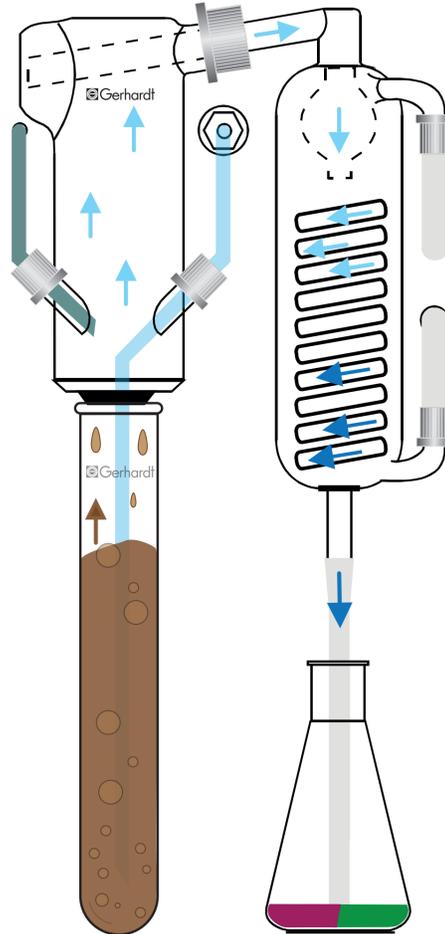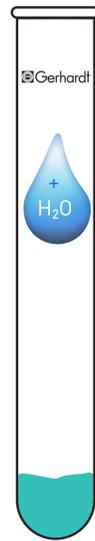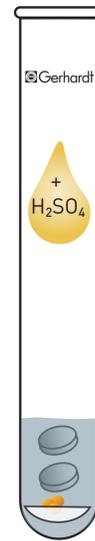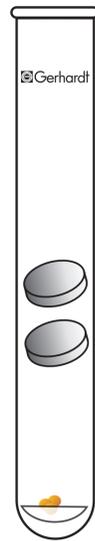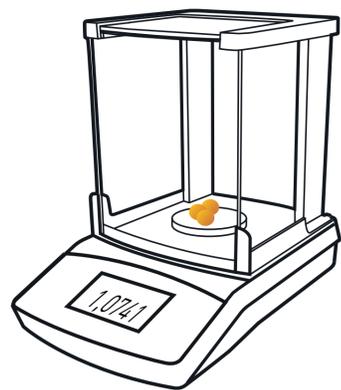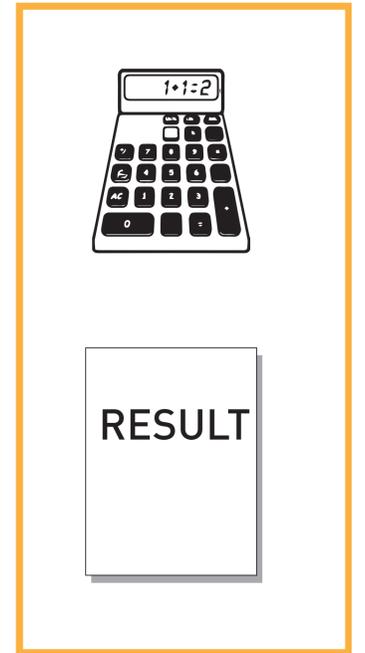
1. Weighing in sample on N free paper.

2. Transfer of sample with weighing boat into digestion tube

3. Addition of salt to raise boiling point and as catalyst, e.g. KJELCAT Cu

4. Addition of sulphuric acid

5. Digestion at boiling point, for about 60 to 180 minutes

$C_nH_mN_x + H_2SO_4 \longrightarrow n\,CO_2 + \tfrac{1}{2}\,m\,H_2O + \tfrac{1}{2} \times (NH_4)_2SO_4$ (solv)

6. Dilution of sample solution with water to prevent strong reactions by following addition of caustic soda. This can be done automatically in some VAPODEST® steam distillation units.

7. Addition of caustic soda to release ammonia, today this is done automatically in modern steam distillation units like VAPODEST® $NH_4^+ + OH^- \longrightarrow NH_3\uparrow + H_2O$

8. Seperation of ammonia by steam distillation and trapping the condensated ammonia-water solution in boric acid (8a).
$NH_3 + H_3BO_3 \longrightarrow NH_4^+ + H_2BO_3^-$

9. Quantitative determination of nitrogen by titration with sulfuric or hydrochloric acid. With direct pH measurement with pH electrode or with pH indicator.
$NH_4^+ + H_2BO_3^- + HCl \longrightarrow NH_4Cl + H_3BO_3$

10. Calculation

Nitrogen content:

$$\% N = \frac{1,4007 * c * (V - V_b)}{E}$$

c – H⁺ Ion concentration of standard volumetric solution:
hydrochloric acid c (H+) = 0,1 mol/l
alternatively: sulfuric acid c (H⁺) = 0,1 mol/l (c(H₂SO₄) = 0,05 mol/l)

V – Consumption volumetric standard solution sample [ml]

V_b – Consumption volumetric standard solution blank [ml]

E – Weight [g]

Calculation protein content:

% Crude protein = % N * PF

Protein content is calculated by a factor (PF)

Examples of protein factors:

6.38	Milk, cheese, milk powder and milk powder products (including milk-based infant formulae, milk protein concentrate, whey protein concentrate, casein and caseinate) Not applicable for samples containing ammonium caseinate
6.25	Meat, fish, poultry, egg, vegetables, fruits, different types of grain, corn, legumes, feed
5.95	Rice
5.71	Soy beans
5.7	Wheat and wheat flour
5.55	Gelatin
5.4	Oliseeds, Nuts

Note: The listed protein factors are often applied. Depending on regulation the analysis is based on, different protein factors must get applied. Especially in grain, nuts and oilseeds or single components of the above described sample types.