Determination of total Ti in Candy

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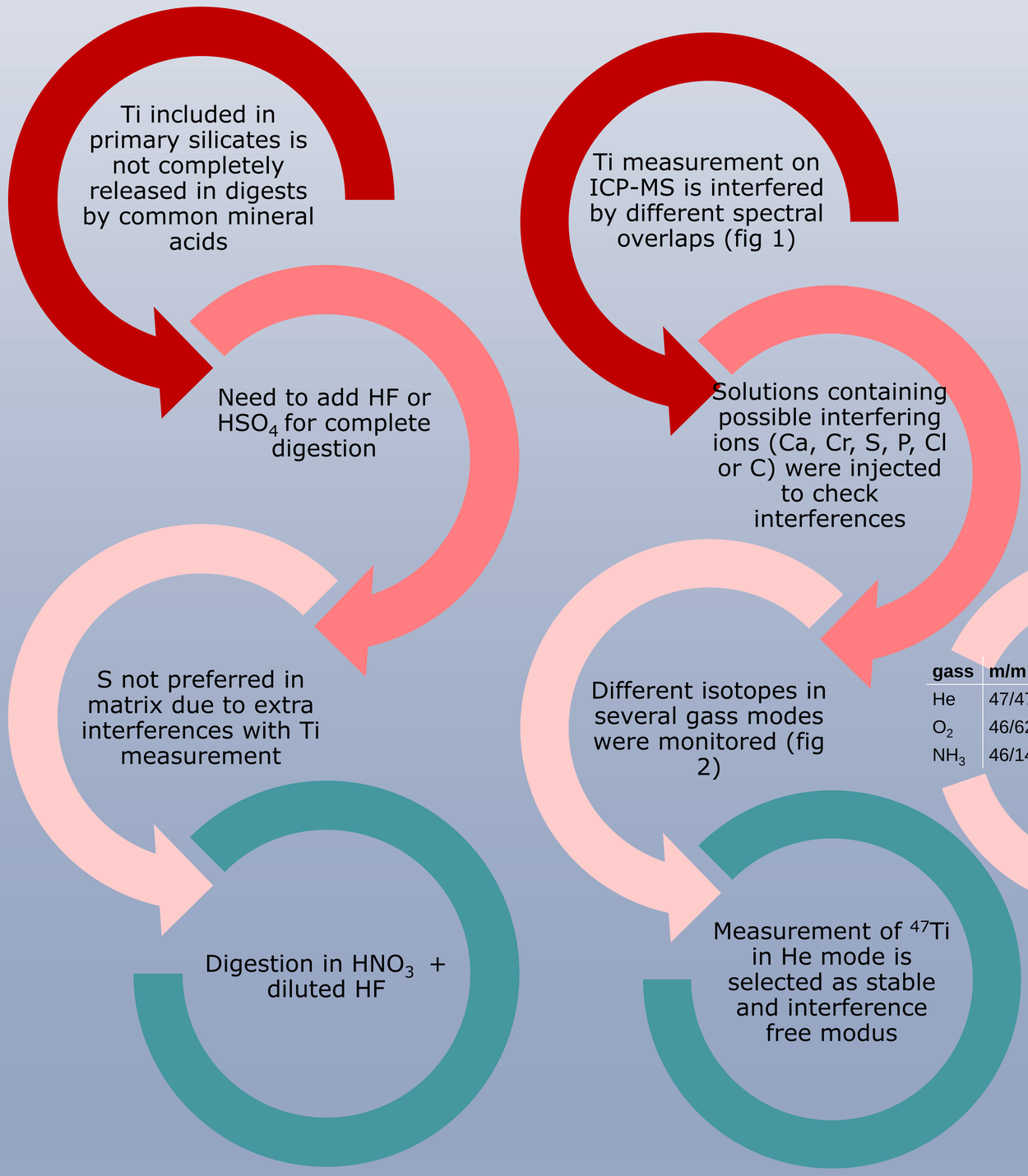
Introduction

Artificially manufactured TiO_2 is a common additive in the food industry. Especially in sweets it is used as the whitest and brightest known pigment. The additive (E171) is permitted in food processing with no maximum level specified. However, recent knowledge about nanoparticles has opened the discussion about the toxicology of nanoparticle TiO_2. A risk assessment has not been published yet because of the complexity of the nanoparticles (mineral forms, coatings, size, shape, …), the lack of toxicity data and the analytical difficulties for measuring these particles in relevant food matrices. Measuring total Ti can be used as screening method before further analysis on nanoparticle TiO_2.

Digestion



Measurement

Isotope (abundance)	Possible interfering ions
^{46}Ti (7.99 %)	$^{34}S^{14}N^+$, $^{14}N^{16}O_2^+$, $^{15}N_2{}^{16}O^+$
^{47}Ti (7.32 %)	$^{34}S^{14}N^1H^+$, $^{30}Si^{16}O^1H^+$, $^{32}S^{15}N^+$, $^{33}S^{14}N^+$, $^{15}N^{16}O_2^+$, $^{14}N^{16}O_2{}^1H^+$, $^{12}C^{35}Cl^+$, $^{31}P^{16}O^+$,
^{48}Ti (73.98 %)	$^{32}S^{16}O^+$, $^{34}S^{14}N^+$, $^{35}S^{15}N^+$, $^{14}N^{16}O^{18}O^+$, $^{14}N^{17}N_2^+$, $^{12}C_4^+$, $^{36}Ar^{12}C^+$, $^{48}Ca^+$
^{49}Ti (5.46 %)	$^{32}S^{17}O^+$, $^{32}S^{16}O^1H^+$, $^{35}Cl^{14}N^+$, $^{34}S^{15}N^+$, $^{33}S^{16}O^+$, $^{14}N^{17}O_2{}^1H^+$, $^{14}N^{35}Cl^+$, $^{36}Ar^{13}C^+$, $^{36}Ar^{12}C^1H^+$, $^{12}C^{37}Cl^+$, $^{31}P^{18}O^+$
^{50}Ti (5.25 %)	$^{32}S^{18}O^+$, $^{32}S^{17}O^1H^+$, $^{36}Ar^{14}N^+$, $^{35}Cl^{15}N^+$, $^{36}S^{14}N^+$, $^{33}S^{17}O^+$, $^{34}S^{16}O^+$, $^1H^{14}N^{35}Cl^+$, $^{34}S^{15}O^1H^+$, $^{50}Cr^+$, $^{50}V^+$

Figure 1: Natural isotopes of Titanium and the possible interfering ions

gass	m/m
He	47/47; 48/48;
O_2	46/62; 47/63; 48/64; 50/66
NH_3	46/148; 47/149; 48/150; 50/152

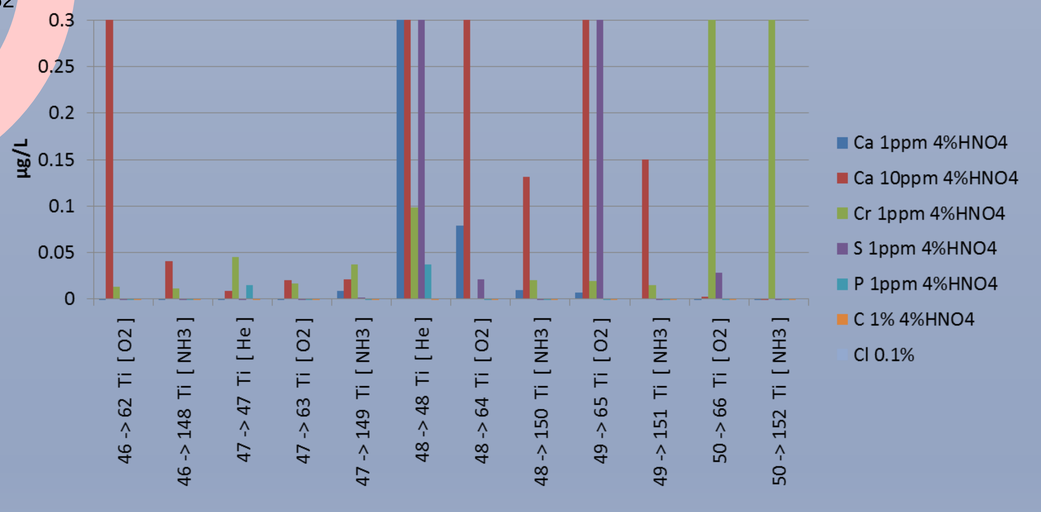
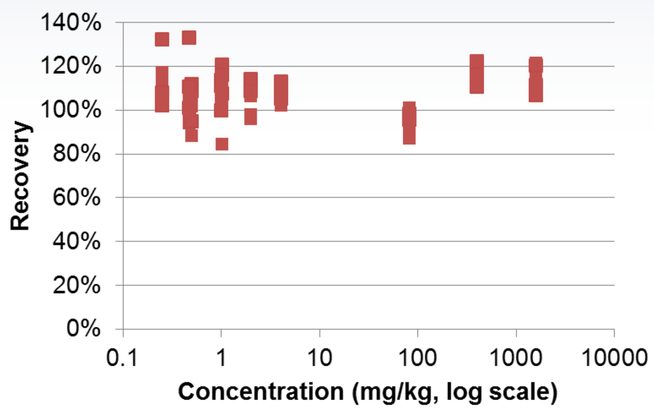


Figure 2: concentration of Ti in solutions containing possible interfering ions. (Y-axis is cutt-off at LOQ (0.3 µg/L)

Validation

The method was validated for different kind of sweets, with a broad application domain (0.16 mg Ti/kg – 390 mg Ti/kg) and resulted in:



LOQ in the matrix : 160 µg/kg

Pooled **bias**: 8.2 % -> was not significant

Repeatability 3.5%

Reproducebility 5.6 %

Expanded **measurement uncertainty** for the method U: 20.2 %

Figure 3: Trueness of spiked candy's at different concentrations