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Title Salt Meter For Food

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Aim

To assess the efficacy/effectiveness, safety and economic implication of salt meter as a measuring device for monitoring salt/sodium content in foods.

Conclusions and results

A total of 59 titles were identified through the Ovid interface and PubMed. After removal of 53 irrelevant or duplicate articles, six titles were screened. Of these, four relevant abstracts were retrieved in full text. After reading, appraising and applying the inclusion and exclusion criteria to the four full text articles, all the articles were included, which comprised of experimental laboratory studies.

Safety: There was no evidence retrieved from the studies on the safety of salt meter in measuring salt/sodium content in food.

Effectiveness: There were four included studies on the efficacy of the salt meter which comprised of two studies on ion selective electrode (ISE) method, one study on thermometric endpoint titrimetry (TET) and one study on ISE and potentiometric titration of chloride ion. No retrievable evidence was found for the efficacy of conductivity method and refractometry method. (Table 1)

Table 1 : Summary of evidence on the efficacy of salt measurement by different methods

STUDY	**Kindstedt PS et al. (2016)**	**Florence E (2014)**	**Ehling S et al. (2010)**	**Ploegaerts G et al. (2015)**
TYPE OF FOOD ANALYSED	Cheeses	1. Cheeses 2. Butters 3. Finished salted food products	Finished food products with low sodium content (≤140mg/ reference amount)	Tomato ketchup sauces - supermarket ketchup -low sodium ketchup -homemade spiked ketchup
TYPE OF PREPARATION	Dispersion in water	Dispersion in water	Dispersion in water	1. Dispersion in water 2. Wet digestion 3. Dry ashing
REFERENCE METHOD	AAS	Method A: AAS Method B: Volhard Titration Method	1. ICP/MS 2. AAS	1. AAS 2. FAES 3. ICP-AES
INTERVENTIONS / OUTCOMES				
Ion selective electrode (ISE)	Accuracy: - Correlation of ISE with AAS, r = 0.99 -Comparative results of the 2 methods differed by 0.06 ± 0.04% Na. Precision: - RSD ≤ 0.02% sodium - Coefficient variation (CV)=0.006-0.024 Sensitivity: Standard additions: 0.5mg-2.5mg sodium, was excellent for all cheeses.	Accuracy: **Cheeses** - r = 0.996 with AAS - spike recovery =97-102% **Butters** Comparative results : 9% and 7% higher than the reference method A and B results, respectively (sodium ion in oil) **Finished salted food products** Comparative results: good agreement between 3 methods for all foods.	Accuracy Spike recovery: Liquid foods – 99 -126% Dry foods – 89-101% Nuts -75-92% Butter – 79.2% Precision Median within-day and interday RSD were 5.6% and 6.2% respectively. (Ref method: median RSDs of 2.7% and 3.5%)	**AAS** – Atom **ICP/MS** – Spectrometry
Automated Method Titration Potentiometric Titration Chloride Ion			Accuracy - Calculated chloride to Na ratios were widely variable, ranging from 0.3 in cookies to 30 in pasta. - Food with very low concentration of chloride ions (below the LOQ, about 35 mg/g), chloride- to-Na ratio could not be determined. Precision Within-day and interday RSD values were 0.12–3.1% and 0.3–4.4%, respectively	
Automated Method Titration Thermometric endpoint titrimetry (TET)				Accuracy - spiked recovery = 99-101% Precision: RSD = 1% Limit of detection(LOD) =0.1g Na $100g^{-1}$ Limit of quantification (LOQ) =0.3g Na $100g^{-1}$
Conductivity meter	No retrievable evidence			
Refractometer	No retrievable evidence			

AAS - Atomic Absorption Spectrometry, **FAES** - Flame Atomic Emission Spectrometry
ICP/MS - Inductively coupled plasma/MS, **ICP-AES** - Inductively Coupled Plasma-Atomic Emission

There was limited retrievable evidence to demonstrate the efficacy of ion selective electrode and titration methods in measuring salt/sodium content in food:

Ion selective electrode (ISE)

- In measuring sodium content in cheese
  - Correlation between ISE with reference atomic absorption was 0.99 and comparative results of the two methods differed by an average of 0.06 ± 0.04% sodium.
  - The procedure was rapid with analysis time in laboratory of seven to eight minutes per sample, including time required to calibrate the instrument, weigh and analyse the sample.
- Good precision was achieved for a variety of cheese and other salted foods with reference to a standard methods (atomic absorption spectrometry and Volhard titration).
- In measuring sodium content in low sodium foods (food products containing 140mg or less sodium per serving), ISE was less precise (median RSD of 5.6%). Ion selective electrode did not perform well in fatty foods (such as cookies, peanuts, and almond butter) or at very low sodium concentrations (<100µg/g).

Titration

a. Automated Potentiometric Titration Chloride Ion

- Analysis of chloride content did not produce reliable sodium estimates in low-sodium foods (<100µg/g).
- In certain starchy, high-fat matrices, such as cookies, granola, peanuts, and potato chips, incomplete extraction of chloride ions led to slow response of the electrode.
- Sample preparation with dispersion and blending with water was considered adequate.

b. Thermometric endpoint titrimetry (TET)

- The analytical sensitivity of the TET was very low in comparison with those obtained for spectrometric techniques [(flame atomic absorption spectrometry (FAAS), flame atomic emission spectrometry (FAES) and inductively coupled plasma-atomic emission spectrometry (ICP-AES)].
- Limit of detection and LOQ values of TET were very high.
- Relative standard deviation of the thermometric titration was comparable to those of the spectrometric techniques.
- Thermometric endpoint titrimetry could not determine sodium content at traces level (<0.1 g Na 100g-1)
- Dispersion preparation of the food sample was the preferred method with TET

Cost/ cost-analysis: There was no retrievable scientific evidence on the cost-effectiveness of salt meter.

Recommendations (if any)

Based on limited retrievable evidence, salt meter using ISE method may be used for detection of sodium level in food. However, ISE may have limited use for fatty foods.

Methods

Electronic databases were searched through the Ovid interface: Ovid MEDLINE® In-process and other Non-indexed citations and Ovid MEDLINE® 1946 to present, EBM Reviews - Cochrane Central Register of Controlled Trials - February 2018, EBM Reviews - Cochrane Database of Systematic Reviews - 2005 to March 2018, EBM Reviews - Health Technology Assessment – 4th Quarter 2016, EBM Reviews – NHS Economic Evaluation Database 1st Quarter 2016. Searches were also run in PubMed. Google was used to search for additional web-based materials and information. No limits were applied. Additional articles were identified from reviewing the references of retrieved articles. Last search was conducted on 15 March 2018.

Further research/reviews required

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