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The sensor for food freshness

Various estimates of the amount of food wasted in the world vary between 33% and 50%. A comprehensive survey of the issue can be found here:
https://en.wikipedia.org/wiki/Food_waste

It would be advantageous in certain situations to employ a chemical sensor which could give a warning of imminent spoilage in foodstuffs of various kinds, for example in storage (in bulk or in domestic refrigerators) by means of fixed monitors, or in market food displays by means of a portable, hand-held screening device.

The basic fuel cell electrochemical sensor such as is used in breathalysers is sensitive to substances other than alcohol. This "cross-sensitivity" is of no consequence in breath alcohol measurement but it can provide the basis for early detection of the emission of decay products in food. Tests we have carried out have shown the following possible areas of application:

- Fruit and vegetables, arising from fermentation of sugars to form ethanol
- Milk and milk products, identities uncertain
- Meat, probably due to release of primary amines
- Fish, probably due to release of secondary amines.

The sensor can be configured as a continuous analyser, but in many cases an intermittent pumped sample may be more appropriate. For continuous monitoring, we recommend the product code 2-FF11. For sampling, we recommend the product code 2-FF16.

A high gain dual rail current to voltage amplifier (a pcb is available for development on our web site) is required, such as the formaldehyde sensor circuit here:

https://dart-sensors.com/wp/wp-content/uploads/2014/10/HCHOSensorDatasheet.pdf

and additionally a small electric pump when a discrete periodic sample is required:

https://www.dartsensors-sz.com/showpro.asp?id=70

The indication is not 100% reliable, there will be false positives or negatives depending on how it is set up. Some foodstuffs (watery, such as cucumber and celery, and leafy) give no detectable gases. Application to potato storage has so far proved problematic. Some fruits (such as banana) give copious vapours of ethylene while still ripening. Application to storage of single foodstuffs is probably less demanding, but if monitoring a broad range of foods it is probably best to grade the signals into colour bands such as:

GREEN: no concerns
YELLOW: possible concern
RED: probable concern.

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Revised 28th November 2019

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The table below shows a number of tests carried out, so treated. The sensor was continually exposed to each sample for up to ten minutes in a covered beaker. The baseline is about 250. There seems to be a good separation into fresh, ripening and overripe/rotting states.

Further work to attempt to differentiate between foodstuffs has so far been disappointing.

The technology is new and still evolving. Dart Sensors offers to cooperate closely with developers to attempt to accelerate its acceptance.

GREEN – Fresh food		YELLOW – Ripening/ maturing food		RED – rotting food	
BASELINE	260*	Two apricots	288	Rotting small tip of red pepper	302
EMPTY JAR	263	Yellow banana	893	Stale cut lemon	1023 in 1 minute
Orange	263	Grated hard cheese	409	Bad end of onion	1023 in 2 minutes
Apple	264	Soft carrot	454	Bad slice of peach	1010
Grapefruit	263	Soft peach	1023 in 9 mins.	Fish after two days	1023 in 1 minute
Milk	254	Soft avocado	417	Beef mince 5 days (mould forming)	1023 in 2 minutes
Potato	254	Beef mince 3 days	441	Two bad peaches	804
Goat cheese 3 days before use date	258	Milk 2 days	312	Avocado two days	1023 in 3 minutes

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ISO 14001 ENVIRONMENTAL MANAGEMENT

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