Intelligent food packaging: RFID bio-based sensing label to monitor food shelf life
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To cite this version:
Jean Clency Fabien Bibi, Nathalie N. Gontard, Carole Guillaume, Brice Sorli. Intelligent food packaging: RFID bio-based sensing label to monitor food shelf life. EcobioCap Final Meeting, Feb 2015, Montpellier, France. hal-02796577

HAL Id: hal-02796577
https://hal.inrae.fr/hal-02796577
Submitted on 5 Jun 2020

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Intelligent food packaging
RFID bio-based sensing label to monitor food shelf life

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Objective

Development of the sensing bio-material

Detection

Threshold concentration in volatile markers of food degradation

Coupling of RFID (Radio Frequency IDentification) tag with the sensor

RFID: Wireless system for transferring data from a tag attached to an object
Sensor: Dielectric material

**Vegetal protein:** Wheat Gluten

- “bio” material and can be coated onto a substrate.
- displays sensitivity to gases and vapors (considered as food quality markers).
- exhibits electrical properties and dielectric properties (Dipoles, charges, charged molecular chains).

![Image of a dissymmetric molecule with high permanent dipolar moment.](image-url)

Dissymmetric molecule (High permanent dipolar moment)
Effects of electric field on Wheat Gluten

- Alternating electric field impacts:
  - Movement of molecular chain,
  - Rotation of dipoles,
  - Movement of charge.

Energy stored (dipoles, polarization): rep. by permittivity ($\varepsilon'$).
Energy loss (conduction, friction): rep. by dielectric loss ($\varepsilon''$).
Effects of relative humidity (RH) on wheat gluten

**Permittivity**

- **Temp:** 25°C
- **Air:** 20% O₂, 0% CO₂, 80% N₂

**Dielectric loss**

- **Temp:** 25°C
- **Air:** 20% O₂, 0% CO₂, 80% N₂

Increase of permittivity with increase in RH.
- More polarizations because of water (dipole).
- Increase mobility of molecular chain and dipoles.

(Electromagnetic properties: Dielectric properties of food)

Increase in dielectric loss with increase in RH.
- Increase mobility of charges in the network. (J.Ahmed, 2007).
RFID (Radio Frequency IDentification)

How does RFID work?

- Wave emission
- Wave captured by the antenna
- Power supplied to microchip
- Wave emitted back to the reader

Reflected Power and reading distance
RFID + wheat gluten coated: Effects of relative humidity

- Effects of humidity on wheat gluten (permittivity and dielectric loss) => Modification of electrical property of RFID antenna.
  - Modification in reflected power.
  - Modification in reading distance.

RFID tag with wheat gluten layer deposited – Impact on reading distance

![Graph showing the theoretical read range forward (m) vs. frequency (MHz)]

- WG-RFID tag
- WG-RFID tag + moisture
- WG-RFID tag + moisture + drying

-2 m
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Thank you for your attention!!