

Consumer attitudes towards time-temperature indicators

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Background of the study

- Time-temperature indicators (TTIs) are tools to monitor the integrity of cold chain
 - applicable in various industries such as food and health care
 - one purpose of TTIs is to prevent spoiled food products to reach the hand of end-customers
- The basic principle of technology is to indicate if product is exposed to unwanted temperatures
 - suitable for fresh and frozen food products
- TTIs have been developed for several decades – without notable success despite the several benefits of technology

Aim and method of the study

- The aim of the study was to evaluate the factors decreasing and increasing French, German, Greek and Finnish consumers' interest in smart label applications to the food products.
- In the end, the results were intended to contribute to further TTI development and implementation
- Mixed-method approach:
 - 1) Qualitative focus group study:
 - Consumers' evaluation of TTI concept, development of an ideal TTI and evaluation of actual TTI applications
 - 2) Quantitative survey
 - Added value and relevance of TTIs to consumers
- Greek data:
 - 1) Focus group study in Athens region: 4 groups, each having consumers with different background (n=40)
 - 2) Quantitative survey in Athens region: n=300

Findings of qualitative consumer study – TTI concept

Time-Temperature Indicator (TTI)

What does it mean?

Rise in temperature during storage and delivery of a food product can boost microbial growth which leads to product spoilage. The product might no longer be safe for food consumption. The basic idea of TTIs is to monitor that food products have not exposed to unwanted temperatures too long.

Time-temperature indicators (TTIs) are labels which monitor the different temperature of products such as fish, meat and poultry from production until the consumer's fridges. TTIs can be attached to different food packages and they are relatively small in size.

How does it work?

TTI has a symbol which changes colour. In case of exposure to unwanted temperature, the colour will change (e.g. from green to red) which indicates that product might be in risk of deterioration and it should be consumed with caution. Due to the technology behind TTIs, the colour change is irreversible.

The TTI is sensitive to changes of temperature. The time and temperature increase have influence on the colour change and therefore on the remaining shelf life. Following scenarios try to explain what is behind different colours of the labels.

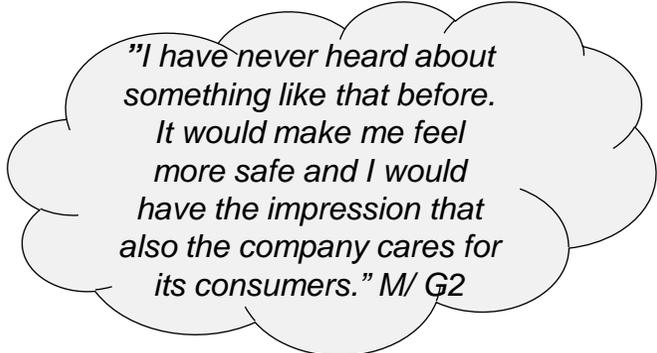
OVERALL IMPRESSION/ REACTIONS TO THE CONCEPT

When participants were exposed to the concept, the following become evident...

Overall, high level of likeability and appreciation of the concept. It is seen as a concept which is rather innovative (have never heard about something like that before). This is mainly due to the fact that...

The concept entails notions of :

- Clarity / simplicity / comprehensiveness → clear cut message and tangible benefits for the consumer
- Meaningfulness → offers safety and security ← relevant to consumers
- Beneficial → protection of own self in case of exposure of the product to unwanted temperatures



"I have never heard about something like that before. It would make me feel more safe and I would have the impression that also the company cares for its consumers." M/ G2

Findings of qualitative consumer study – TTI concept

RELEVANCE TO TARGETS

The specific concept appears very relevant to consumers and especially nowadays where suspiciousness predominates (feeling is that both manufacturers and retailers do their best to sell their products without caring for the consumers → nobody controls transport conditions and conditions that products are exposed to)

To that end, the specific smart label is seen as very useful (at least for the consumer) as it offers them “control” over the “journey” of the product

Based on the aforementioned, consumers find the smart label necessary to be incorporated in all fresh and vulnerable products.

Still, it should be mentioned that consumers confront this mechanism as beneficial for that time where they do not have the control (transportation from manufacturer to the retailer). On the contrary, they trust themselves and feel secure about transportation of the product from supermarket to their home

A quote is enclosed in a light grey, cloud-like bubble with a black outline. The text inside the bubble is italicized and reads: "The truth is that I don't care very much about this label while transporting the product to my home, because I know the conditions in which it is transported and preserved. But it would make me feel much more safe about the conditions where I do not have the control" M/ G1

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Findings of qualitative consumer study – TTI concept

PURCHASE BEHAVIOR

If any changes to consumers' purchasing behavior, it seems that overall main selection criteria would not change – smart label would function more in the direction of an “additional”, an “add-on” selection criterion which would offer consumers feeling of additional safety

To that end, TTI would not replace existing selection criteria (consumers would continue checking the colour of the food, the expiration date, the origin). Still, it is worth mentioning that consumers would not purchase a product with a label showing even a mediocre decay condition (e.g. orange colour)

If products with the smart label would cost much more, minimal intention for purchase is observed, since it is claimed that this label should not cost more (manufacturers should have it either wise) and in addition, during these days – where financial crisis dominates – paying much more is out of the question the maximum that consumers are willing to pay is approximately 0.10 euro

“With this label it does not mean that I will not give emphasis any more to the expiration date or other visual tricks; still, it will be another criterion in the selection process.” F/ G3

“It's very useful. However, I would search in the shelf for a total green label. I would never choose an orange one.” F/ G3

Findings of qualitative consumer study – TTI concept

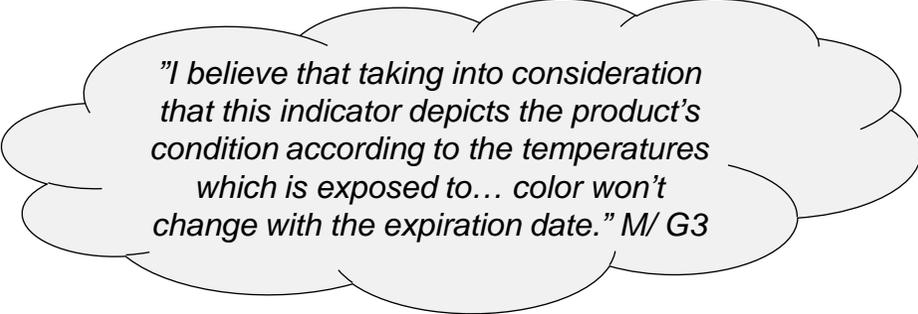
WAYS OF CONSUMPTION AND THROWING AWAY FOOD

Smart labels reflect on changes in consumption and storage behavior. More specifically, the following are observed:

- Consumers would not easily consume a product with a label indicating even minor deterioration
- Consumers would not give at all to their child a product with label indicating even minor deterioration
- Consumers would be confused if the label shows deterioration and the expiration date has passed (and vice versa)
- Consumers would possibly throw away the product even with a slight colour change

A light gray thought bubble with a black outline, containing a consumer quote.

"Will the colour of the label change when the expiration date come? Otherwise, I will think that it may not work properly." F/ G4

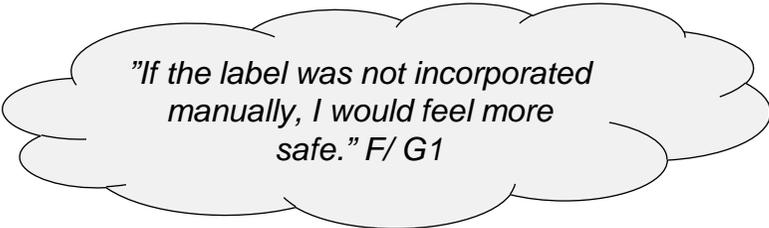
A light gray thought bubble with a black outline, containing a consumer quote.

"I believe that taking into consideration that this indicator depicts the product's condition according to the temperatures which is exposed to... color won't change with the expiration date." M/ G3

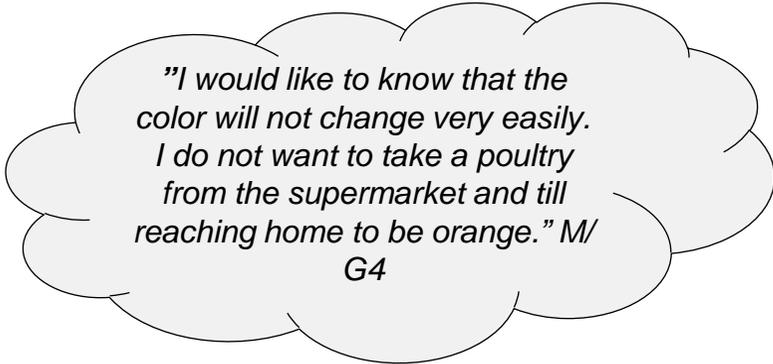
Findings of qualitative consumer study – Ideal TTI from Greek consumers' viewpoint

As participants were describing their perception of ideal TTI, the following came up:

- Smart label to be incorporated in the package – not added manually
- Smart label not being very sensitive in temperature changes (e.g. no color changes while the product is transported from supermarket to home)
- Simplicity in description → consumers are interested in knowing that the indicator changes with temperature
- Usage of familiar colours (green and red are much more to the point)

A light gray thought bubble with a black outline, containing a quote from a participant.

"If the label was not incorporated manually, I would feel more safe." F/ G1

A light gray thought bubble with a black outline, containing a quote from a participant.

"I would like to know that the color will not change very easily. I do not want to take a poultry from the supermarket and till reaching home to be orange." M/ G4

Findings of qualitative consumer study – Evaluation of two actual TTI applications

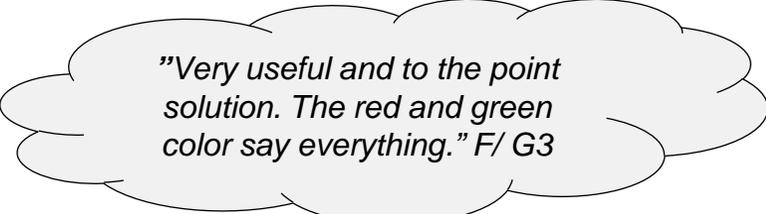
TTI1 description:

“The first TTI solution is based on technology in which two liquids are integrated. Together they form a liquid which reacts with temperature and causes a colour change if TTI is exposed to unwanted temperature for too long. When the TTI is ok, the colour is green (see, picture). Once exposed to unwanted temperature, the colour will slightly change in orange/red (see, picture). This colour change means that the product might be deteriorated and it should be consumed with caution. The colour change is irreversible, once the chemical reaction is occurred, it can’t be revised.”

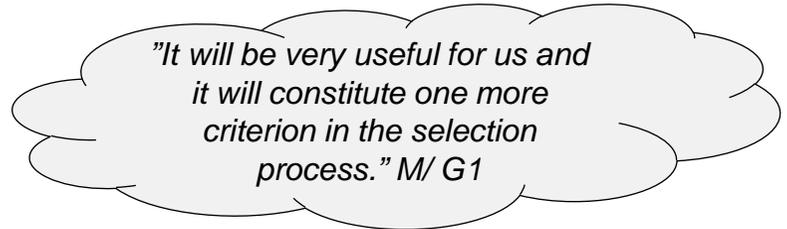
“The TTI can be used with different fish, poultry and meat products. The label is not integrated with the package; it is included manually with non-toxic glue behind the TTI. Moreover, the liquids used in TTI are non-toxic and cannot be exposed to the product.”

INITIAL IMPRESSION

Overall, a concept which received great enthusiasm from all respondents due to its clarity and comprehensiveness, adding to the product values of quality and offering to consumers safety and trustworthiness



“Very useful and to the point solution. The red and green color say everything.” F/ G3



“It will be very useful for us and it will constitute one more criterion in the selection process.” M/ G1

Findings of qualitative consumer study – Evaluation of two actual TTI applications

DEGREE OF USEFULNESS AND ADDED VALUE TO FISH, MEAT AND POULTRY

ADVANTAGES of TTI1

- Additional guarantee of quality
- Stronger notions of safety – more protected consumer
- Informs on the conditions that the product has undergone
- Protects consumers health
- Clear and comprehensive mechanism
- Enhances notions of trustworthiness due to the non reversible colour → an element which should be emphasized in the communication

"This label will be very useful not only for us but also for our children." F/ G4

DISADVANTAGES of TTI1

The only disadvantage of TTI1 is the fact that the label is not integrated in the package, but instead it is added manually → a condition that downgrades trustworthiness since they believe that it may be adulterated by retailers

"If the label is included manually, how can I feel safe that the retailer won't put a new one if it becomes red while the product being on the shelf – fridge?" M/ G1

Findings of qualitative consumer study – Evaluation of two actual TTI applications

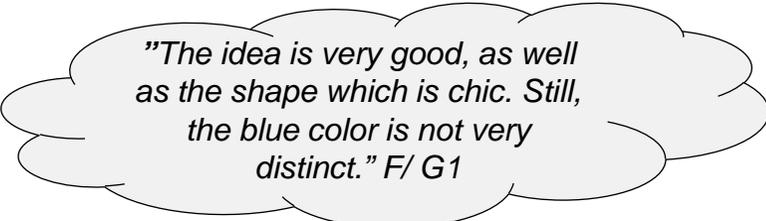
TTI2 description:

“The second TTI is based on technology in which the label is activated with UV light. Due to the activation, the label will turn in blue (see, picture). In case of exposure to unwanted temperature, the blue colour will slowly fade away depending on the time of exposure. Once the shade of blue colour has reached to the point described in TTI with red cross (see picture, left side of the TTI), the food product might be deteriorated and you should consume it with caution. The colour change is irreversible, once the reaction with temperature is occurred, it can't be revised.”

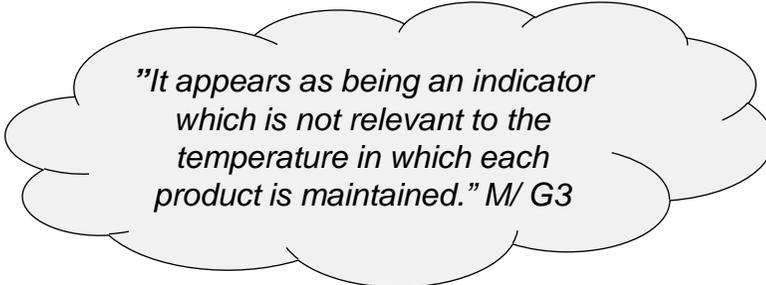
“The TTI can be used with different fish, poultry and meat products. The label is not integrated with the package. There is non-toxic glue behind the TTI and it could be included in package manually. Moreover, the chemicals used in TTI are non-toxic and cannot be exposed to the product.”

INITIAL IMPRESSION

Overall, the specific concept received low levels of appeal. This is mainly due to the fact that the description of TTI2 does not appear to be helpful – people cannot understand neither how the mechanism works (label is activated with UV light) while they have difficulties understanding how the label is interpreted



“The idea is very good, as well as the shape which is chic. Still, the blue color is not very distinct.” F/ G1



“It appears as being an indicator which is not relevant to the temperature in which each product is maintained.” M/ G3

Findings of qualitative consumer study – Impressions on two actual TTI applications

DEGREE OF USEFULNESS AND ADDED VALUE TO FISH, MEAT AND POULTRY

ADVANTAGES of TTI2

As in the case of TTI1...

It is seen as a way to protect own self and own family

It is useful since it informs consumer as regards the quality of the product

It protects own health

It enhances notions of trustworthiness due to the non reversible colour → an element which should be emphasized in the communication

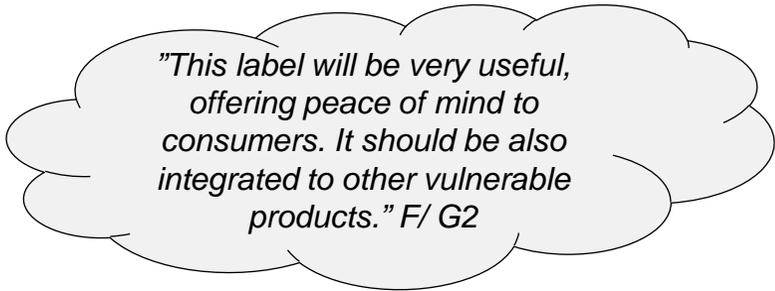
DISADVANTAGES of TTI2

The mechanism is not well understood (activation with UV light → respondents are nor really aware of the UV light, a fact which downgrades reliability since suspiciousness arise)

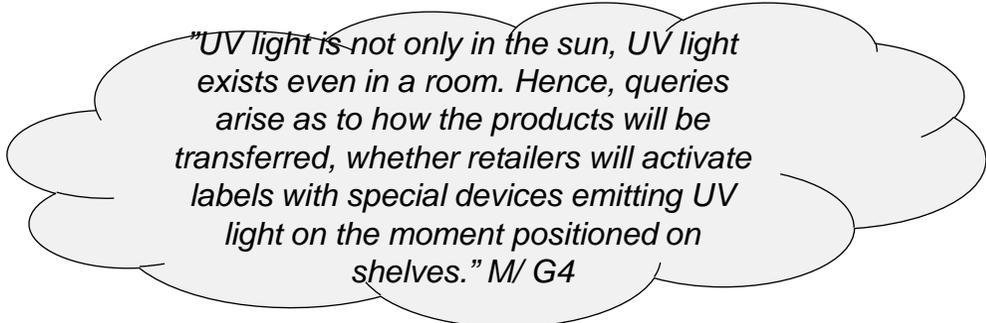
The label is not integrated with the package, but instead it is included manually → another condition that downgrades trustworthiness

The colour codes are less meaningful

The colour process – from dark to light – is not helpful in being decoded as a warning of decay



"This label will be very useful, offering peace of mind to consumers. It should be also integrated to other vulnerable products." F/ G2



"UV light is not only in the sun, UV light exists even in a room. Hence, queries arise as to how the products will be transferred, whether retailers will activate labels with special devices emitting UV light on the moment positioned on shelves." M/ G4

Results of the quantitative survey – Added value of TTIs

- Quantitative survey results indicate that Greek consumers attach value to TTIs...

TTI related statements	Greece
Scale: 1= strongly disagree... 5= strongly agree	
	n = 299
I feel that a TTI would provide me extra confidence that the retailer has taken good care of the cold chain	4,52
I would prefer to buy at retailer shops that have integrated TTIs	4,24
Products with TTI are of higher quality than the ones without	4,04
A retailer including TTIs in its products would be more trustworthy than a retailer excluding TTIs	4,41
A food manufacturer including TTIs in its products would be more trustworthy than a manufacturer excluding TTIs	4,46
It would be useful to check with TTI that the product has not been exposed to warmth too much while I transported it from grocery store to home	4,45
Using TTI to identify products at the fridge/freezer I have forgotten to use on time would be beneficial	4,39
TTI would lead to less food waste as I would be able to estimate the usability of the products after the expiration date	4,21

Results of quantitative survey – Relevance of TTIs

- ...and consider TTIs relevant for fresh and frozen meat and fish products

Relevance of TTI in different products	Greece (n=299)
Scale: 1= not relevant at all... 5= very relevant	
Fresh fish products	4,57
Frozen fish products	4,70
Fresh meat products	4,53
Frozen meat products	4,68
Fresh poultry products	4,59
Frozen poultry products	4,69

Conclusions

- Overall, Greek consumers appear positive to the existence of TTI label - this label adds value to the product that carries it. The main value attached to the technology are:
 - Increased transparency of food chain and alleviation of risks perceived towards food manufacturers and retailers
 - Improved quality of food products
 - Assistance in own cold chain management
 - Waste reduction
- However, also concerns emerged:
 - Confusion between TTI and other freshness indicators
 - TTI needs to be integrated part of packaging to avoid manipulation
 - Current TTI applications do not completely meet consumers' expectations – mainly due to poor design (appearance and colours used)
 - Also technical mechanism of TTI applications raised concerns (liquids used in TTI1 and UV-activation of TTI2)
- Suggestions for further development:
 - TTI should be incorporated onto the pack for additional reliability
 - Educate consumers about technology
 - How to interpret TTI message
 - How to adapt TTI message into own behaviour
 - How to response in conflicting indications between different freshness labels
 - Pay attention to TTI design, especially in easiness of interpretation



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