

# Consumers' acceptance of active packaging

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## Abstract

The amount of food wasted each year is increasing, at the same time there is a growing consumer demand for minimally processed, more natural food products. Technology has provided a solution, namely, active packaging. In active packaging, the package, the product and its environment interact in a desirable way. These interactions offer a huge potential to reduce food waste and fulfil the consumer demands. It is not clear whether consumers accept this packaging method or not. This is astonishing, as the Genetic Modification (GM) debate has shown, ignoring consumer concerns may hinder public acceptance. To gain insight in consumers' acceptance of active packaging, an online survey was distributed in which the risk and benefit perceptions of consumers were measured and how these influence the acceptance. Four different scenarios were made, respondents were randomly assigned to one of these. Results showed that the higher perceived risks cause lower consumers acceptance and that higher perceived benefits cause higher consumers acceptance. They correlate with each other in a negative way. No significant differences were found between the conditions.



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## **Introduction:**

Due to the ever-growing world population the demand for food increases (Vilela et al., 2018). At the same time the amount of food wasted each year is still increasing. According to the FAO we waste 1.3 billion tonnes of food each year (FAO, SAVE FOOD Initiative). In the EU and USA food waste even reaches 88 million tonnes (FUSION, 2016).

The way a product is packaged can play an important role in reducing food waste. Packaging has several functions; it can prevent undesired reactions, ensure safety, protect against external conditions and increase food shelf life (Poyatos-Racionero et al, 2018).

There is also a growing consumer demand for minimally processed, more natural, and convenient food products with an extended shelf life and controlled quality (Realini & Marcos, 2014; Wyrwa & Barska, 2017; Yildirim et al., 2018). Using traditional packaging it is almost impossible to fulfil these demands (Yildirim et al., 2018). For example, it is hard to extend the shelf life of pre-cut fruits and vegetables without reducing the freshness of it. The changing demands of consumers offer an opportunity to the packaging industry to come up with innovative solutions (Realini & Marcos, 2014).

Technology has provided a solution, namely, active packaging. This way of food packaging goes further than traditional functions of packaging. *'Active food packaging is designed to foster desirable interactions with the packaged food by incorporating active substances intended to be released into the food or absorbed into or from the packaged food or the environment surrounding the food'* (European Commission, 2009). In active packaging the package, the product and its environment interact in a desirable way. These interactions have several advantages, for example the shelf life of food is extended and safety is improved without reducing the quality of the food (Ahvenainen, 2003). Active packaging changes the conditions of the packed food, and controls its quality at the same time (Wyrwa & Barska, 2017). It offers a huge potential to reduce food waste (Poyatos-Racionero et al, 2018).

Active packaging systems are considered as an innovation in the field of food packaging.

Although active packaging seems the technological solution to compete with consumer demands for fresh food products and helps with reducing food waste, little research was done on consumer acceptance on active packaging.

This lack of research is astonishing since it is essential that consumers do see an advantage in active packaging compared to the traditional ways of packaging. When there is a lack of advantages for consumers, it is possible that they will continue buying products packed in traditional packages. A new food technology may be refused by consumers when they are not convinced that this technology does provide additional value to them (Siegrist, 2008). Therefore it is important to investigate the benefit perception consumers have towards active packaging.

In addition, the perceived benefits of an active packaging should outweigh the perceived risks consumers see. As the Genetic Modification (GM) debate has shown, ignoring health concerns may hinder public acceptance (Gaskell et al, 2000; Noussair et al, 2004). There is a lack of research on the perceived risks in the field of active packaging. The possibility that consumers perceive risks could be a reason to refuse it. Therefore it is also important to investigate the risk perception. If the benefits will not outweigh the risks for consumers it is probably not worthwhile to make an active packaging.

The aim of this study is to gain insight in the risk and benefit perceptions of consumers towards active packaging and how these influence the acceptance of it.

## **Research questions**

To achieve this aim, the following research question needs to be answered:

*'What determines consumers' acceptance towards active packaging?'*

Acceptance will be determined by looking at the risks and benefits consumers perceive towards active packaging. It is important that the risks and benefits of active packaging consumers perceive are known. This requires answers to the sub-

question *'What are the risks of active packaging consumers perceive?'* and

*'What are the benefits of active packaging consumers perceive?'* It is also important

to know the combined effect of risks and benefits perceptions on the acceptance.

Therefore the following sub-question is determined *'How do these two combined affect consumers' perspectives towards active packaging?'*

## **Literature review**

### **Active packaging**

To better understand how active packaging works, some background of the technology is required. In active packaging, the atmosphere inside the package can be actively controlled by substances that absorb or release gases or steam. In contrast to the traditional materials intended to come in contact with food, active packaging materials may change the composition and characteristics of it (Wyrwa & Barska, 2017). Active systems are placed outside the primary package, between different parts of the primary package or inside the primary package. In the final case, the active systems can be in contact with the atmosphere surrounding the food, in contact with the food surface or placed inside the food itself (for liquid foods). The nature of the active agents that can be added is very diverse as well as the materials into which they are included such as papers, plastics, metals or combinations of these materials (Dainelli et al, 2008).

### **Acceptance**

In this study the acceptance of active packaging will be investigated by looking at the risks and benefits consumers perceive. Research has shown that consumers purchase products because they seek benefits associated with the product's attributes, which should outweigh the perceived risks (Frewer, 2003; Ronteltap et al, 2007). The weighted sum of the risks and benefits consumers perceive will eventually determine if consumers accept active packaging or if they refuse it. If the perceived risks can be compensated through the perceived benefits, the resulting sum of risks and benefits will positively impact the evaluation of the product and/or the novel technology attribute (Frewer, 2003; Ronteltap et al., 2007; Steenis & Fischer, 2016).

### *Risk perception*

Risk perceptions have been shown to play an important role in the acceptance of food innovations (Ronteltap et al, 2007). The risk perceptions influence the behaviour a person shows and the decisions he makes. Whether a person perceives a technology as risky or not has important implications since this influences the

acceptance of it (Siegrist et al., 2005). For example, people who are afraid of pesticides may consider buying more organic foods instead. In the same way, the strength of perceived risks will influence the acceptance of active packaging. The higher the strength of perceived risks, the less likely it will be for active packaging to be accepted. This results in hypothesis 1.

*H1: Higher perceived risks cause lower consumers' acceptance of active packaging.*

#### *Benefit perception*

Perceived benefit is another important factor which influences acceptance (Frewer, 2003). A Swiss study even suggests that people's acceptance was more determined by the perceived benefits they have compared to the perceived risks (Siegrist, 2000). The perception of benefits influences, like the perception of risks, the behaviour a person shows and the decisions he makes. The higher the strength of perceived benefits, the more likely it will be for active packaging to be accepted. The strength of benefits a person perceives will increase acceptance. This results in hypothesis 2.

*H2: Higher perceived benefits cause higher consumers' acceptance of active packaging.*

#### *Correlation between risk and benefit perceptions*

Gregory and Mendelsohn (1993) found that activities or technologies that are judged high in risk tend to be judged low in benefit and vice versa. When the strength of risks consumers perceive is high, they tend to attach less benefits to active packaging compared to when the perceived strength of the risks are low. The other way around, when the strength of benefits consumers perceive is high, they tend to attach less risks to active packaging compared to when the perceived strength of the benefits are low. This results in hypothesis 3.

*H3: The perceived risks and benefits correlate negatively.*

## **Risks and benefits of active packaging**

The main benefits of active packaging mentioned in literature are the microbiological safety and the extension of the shelf life which results in a reduction in food waste (Ahvenainen, 2003; Dainelli et al, 2008; Poyatos-Racionero et al, 2018; Wyrwa & Barska, 2017). The main risks mentioned in literature are the chemical safety concerns (Dainelli et al, 2008; Farhoodi, 2016; Siegrist et al, 2008). It will be investigated how these concepts influence the risk and benefit perception of consumers and how this influences the acceptance of active packaging.

### *Risks*

#### Chemical safety concerns

The main disadvantages mentioned in literature are chemical safety concerns (Dainelli et al, 2008; Farhoodi, 2016). Consumer concerns regarding safety are important determinants of acceptance (Miles and Fewer, 2001). As the Genetic Modification (GM) debate has shown, ignoring health concerns may hinder public acceptance (Gaskell et al, 2000; Noussair et al, 2004). Research on the safety of nano composite materials, which are used in active packaging, has not been done (Farhoodi, 2016). In active packaging, active systems are in contact with the atmosphere surrounding the food or placed inside the food, the migration of substances from the packaging is a risk (Dainelli et al, 2008). Some nanomaterials are potentially harmful to human health since they exhibit physicochemical properties from their macro-scale chemical counterparts. In addition, the migration of nanomaterial into food materials are very difficult to detect since no individual technique can give all the detailed information needed (Honarvar et al, 2016). These concerns can increase the risks consumers perceive. When people want to avoid these risks, they will seek alternatives like traditional ways of packaging which hinders public acceptance of active packaging. This results in hypothesis 4.

*H4: Higher communication in chemical safety concerns cause lower consumers' acceptance of active packaging.*

## *Benefits*

### Microbiological safety

Despite the fact that the safety concerns of active packaging came forward as a potential risk earlier in this paper, there are also studies that promote that active packaging increases the safety of the packaged food. The focus is more on the microbiological part since active packaging significantly improves the microbiological safety compared to traditional packaging (Wyrwa & Barska, 2017). For example, the growth of bacteria can be reduced through the atmosphere inside the package that absorbs or releases gases or steam (Dainelli et al, 2008). The fact that active packaging significantly improves the microbiological safety is a benefit of active packaging.

### Extension of the shelf life

Besides the improvement of microbiological safety, the extension of shelf life is another benefit of active packaging (Ahvenainen, 2003; Dainelli et al, 2008; Poyatos-Recionero et al, 2018; Wyrwa & Barska, 2017). The extension of shelf life immediately benefits one of the main problems stated in the introduction, namely the increasing amount of food waste. Active components intended to release or absorb substances into, or from the packaged food or from the environment surrounding the food (Dainelli et al, 2008). By doing this, shelf life of a product can be extended since substances which reduce shelf life can be released by the package itself. Food products can be longer available for consumption which reduces the amount of food waste. An important difference in the extension of shelf life in traditional packaging compared to active packaging is the way it is done as explained before. More important is the fact that active packaging supports the freshness of a product better than traditional packaging does (Yildirim et al., 2018). This is important since there is a growing consumer demand for fresh food products (Realini & Marcos, 2014; Wyrwa & Barska, 2017; Yildirim et al., 2018).

The extension of shelf life could be seen as a benefit of active packaging for consumers compared to traditional packaging. When consumers do not attach value to this, for example because they will not wait long with consuming the product and therefore they are not really interested in the extension of shelf life, it will not really strengthen the benefits they perceive. So, for the perceived benefit, it is expected

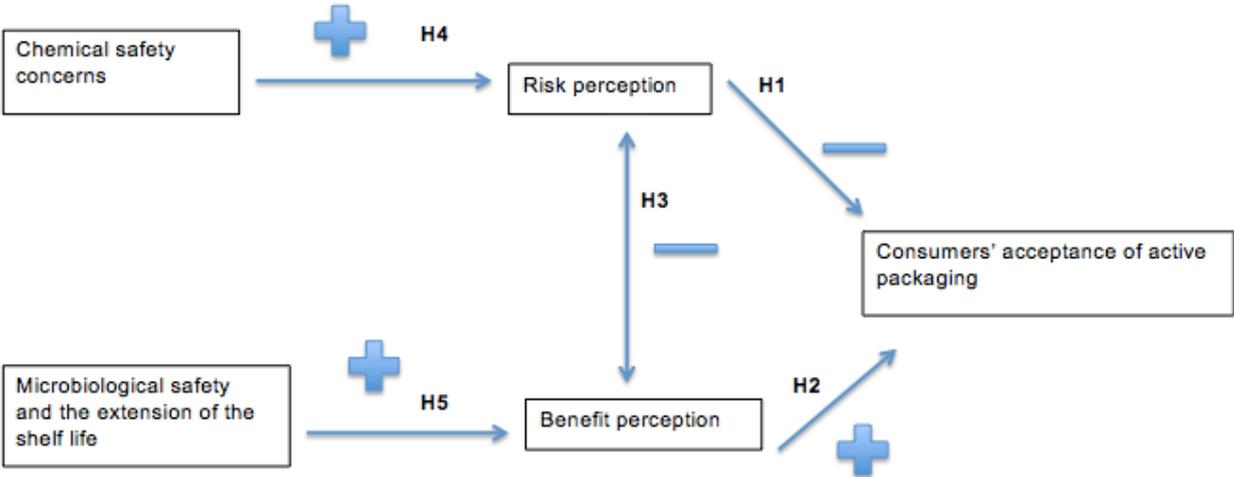
that consumers attach value to the extension of shelf life.

The improvement of the microbiological safety and the extension of the shelf life which results in a reduction in food waste are expected to increase the benefits consumers perceive. This results in hypothesis 5.

*H5: The communication of microbiological safety and extension of the shelf life will have a positive effect on the benefit perception.*

**Conceptual model**

The following conceptual model for consumers' acceptance of active packaging is developed (Fig.1). In the model, consumers' acceptance of active packaging is determined by the perceived risks and benefits. The benefits are the microbiological safety and the extension of the shelf life, these are predicted to increase the perceived benefits. The chemical safety concerns are predicted to increase the risk perception. In addition, a negative correlation effect between risk and benefit perception is expected.



*Fig. 1. Conceptual model for consumers' acceptance of active packaging*

**Method**

### *Design and participants*

A between-subjects design was used, all respondents answered questions of only one specific condition. Respondents were randomly assigned to one of the conditions of a two (information about shelf life vs. no information about shelf life) by two (information about the chemical safety concerns vs. no information about the chemical safety concerns) design.

An online questionnaire was distributed, which was filled in by 121 people. Seven respondents were excluded, because they filled in the questionnaire in less than 90 seconds. This resulted in 114 remaining respondents identified as useful. These useful respondents were between the ages 16 and 68 ( $M_{age} = 28.26$   $SD_{age} = 13.56$ ) and of them 71.1% of were female. All the respondents confirmed that they were at least sixteen years old, they participated voluntarily.

The method used for collecting respondents for this study was convenience sampling. People in my own network were reached via Whatsapp and Facebook. Convenience sampling is a nonprobability sampling method or non-random sampling method that is especially very helpful when the researcher has limited time, workforce and resources (Etikan, Musa & Alkassim, 2016). By using this method, respondents were collected from the available population. A disadvantage of this approach is the high probability of self-selection bias which can cause outliers. Nevertheless, this sampling method is very affordable and very time efficient (Etikan et al, 2016).

### *Procedures and measures*

The online survey started with an introduction text in which was stated that the aim of the study was to gain insight in consumers' acceptance of active packaging.

Respondents were informed that completing the questionnaire would take up to about five minutes. Respondents had to confirm that they were at least sixteen years old. After confirming this statement, respondents were randomly assigned to one of the four conditions as explained above. Every condition received a scenario which will be explained below.

In the *only information about the extension of the shelf life condition* respondents received the following text:

*Vers gesneden fruit kan naast traditionele verpakkingen tegenwoordig ook worden verpakt in actieve verpakkingen. In een actieve verpakking zijn actieve deeltjes actief, deze zijn zo gemaakt dat ze samenwerken met de lucht in de verpakking of met het verpakte product. In tegenstelling tot traditionele verpakkingen kunnen, die deze actieve deeltjes niet bevatten, kunnen deze deeltjes de samenstelling van een product en de kenmerken ervan veranderen.*

*De actieve deeltjes zorgen ervoor dat het fruit langer houdbaar blijft. Fruit kan langer geconsumeerd worden wat er voor zorgt dat er minder wordt verspild. De actieve deeltjes zorgen er daarnaast voor dat de kans op groei van bacteriën en virussen beduidend kleiner is ten opzichte van traditionele verpakkingen. Dit komt de veiligheid van het fruit ten goede.*

In the *only information about chemical safety concerns condition* respondents received the following text:

*Vers gesneden fruit kan naast traditionele verpakkingen tegenwoordig ook worden verpakt in actieve verpakkingen. In een actieve verpakking zijn actieve deeltjes actief, deze zijn zo gemaakt dat ze samenwerken met de lucht in de verpakking of met het verpakte product. In tegenstelling tot traditionele verpakkingen kunnen, die deze actieve deeltjes niet bevatten, kunnen deze deeltjes de samenstelling van een product en de kenmerken ervan veranderen.*

*De actieve deeltjes zijn in contact met de lucht rondom het fruit, sommige van deze deeltjes zouden schadelijk kunnen zijn voor de mens. De precieze effecten zijn erg moeilijk te vinden doordat de actieve deeltjes heel erg klein zijn.*

In the *both information about the extension of the shelf life and chemical safety concerns condition* respondents received the following text:

*Vers gesneden fruit kan naast traditionele verpakkingen tegenwoordig ook worden verpakt in actieve verpakkingen. In een actieve verpakking zijn actieve deeltjes actief, deze zijn zo gemaakt dat ze samenwerken met de lucht in de verpakking of met het verpakte product. In tegenstelling tot traditionele verpakkingen kunnen, die deze actieve deeltjes niet bevatten, kunnen deze deeltjes de samenstelling van een product en de kenmerken ervan veranderen.*

*De actieve deeltjes zorgen ervoor dat het fruit langer houdbaar blijft. Fruit kan langer geconsumeerd worden wat er voor zorgt dat er minder wordt verspild. De actieve deeltjes zorgen er daarnaast voor dat de kans op groei van bacteriën en virussen beduidend kleiner is ten opzichte van traditionele verpakkingen. Dit komt de veiligheid van het fruit ten goede.*

*De actieve deeltjes zijn in contact met de lucht rondom het fruit, sommige van deze actieve deeltjes zouden mogelijk schadelijk kunnen zijn voor de mens. De precieze effecten zijn erg moeilijk te vinden doordat de actieve deeltjes heel erg klein zijn.*

In the control condition no additional information was given to respondents. They received information about what active packaging exactly is. The following text was shown to the respondents:

*Vers gesneden fruit kan naast traditionele verpakkingen tegenwoordig ook worden verpakt in actieve verpakkingen. In een actieve verpakking zijn actieve deeltjes actief, deze zijn zo gemaakt dat ze samenwerken met de lucht in de verpakking of met het verpakte product. In tegenstelling tot traditionele verpakkingen kunnen, die deze actieve deeltjes niet bevatten, kunnen deze deeltjes de samenstelling van een product en de kenmerken ervan veranderen.*

### *Risk perception*

The first mediator, *risk perception* was measured by using a single-item scale

retrieved from Saba et al. (2000). The respondents were asked to rate on a seven-point Likert scale ranging from 'very low' to 'very high' how they associate the risks with the use of active packaging.

### *Benefit perception*

The second mediator, *benefit perception* was measured by using a single-item scale retrieved from Saba et al. (2000). The respondents were asked to rate on a seven-point Likert scale ranging from 'very low' to 'very high' how they associate the benefits with the use of active packaging.

### *Acceptance*

Acceptance was measured in two ways. The first operationalisation focused on the tradeoff between risks and benefits, the second operationalisation focused on the overall attitude of active packaging.

The first operationalisation was a single-item measure of benefits versus risks of active packaging adapted from Binder et al. (2012). The respondents were asked to rate on a seven-point Likert scale ranging from 'De risico's wegen zwaarder dan de voordelen' to 'De voordelen wegen zwaarder dan de risico's' if the risks weigh out the benefits or if the benefits weigh out the risks.

In the second operationalisation on acceptance, the overall attitude towards active packaging was measured on a reduced semantic differential scale based on Crites et al. (1994) that covers the relevant affective, cognitive and general dimensions of attitude. The scale was reduced to seven items. Respondents were asked to score 'Wat beschrijf u reactie naar actieve verpakkingen het beste?' with the endpoints: *onrustig/kalm, onveilig/veilig, negatief/positief, slecht/goed, nadelig/voordelig, angstig/rustig, droevig/blij*. The scale was reliable (Cronbach's alpha of .936).

For the last questions, the respondents were asked to fill in their age and gender. Then they were thanked for participating in the study. For the whole questionnaire, see Appendix: survey questions.

## Results

To show if the presence or absence of '*Chemical safety concerns*' and '*Shelf life*' had an effect on '*Risk perception*' and '*Benefit perception*' two-way ANOVAs were conducted. For the two-way ANOVAs '*Risk perception*', '*Benefit perception*', '*Acceptance*' and '*Attitude*' were the dependent variables. For the independent variables '*Chemical safety concerns*' and '*Shelf life*' were used. First, an overview of the means and the standard deviations of every condition is given (table 1).

Table 1	Chemical safety concerns			
	No		Yes	
	Shelf life		Shelf life	
	No	Yes	No	Yes
	mean(SD) n= 26	mean(SD) n=29	mean(SD) n= 29	mean (SD) n= 30
<b>Risk perception</b>	3.08(1.623)	3.34(1.317)	3.38 (1.590)	3.63 (1.45)
<b>Benefit perception</b>	4.77 (1.394)	5.21(1.207)	4.31(1.561)	4.83(1.177)
<b>Acceptance</b>	4.42 (1.579)	4.76 (1.244)	4.55 (1.804)	3.83 (1.367)
<b>Attitude</b>	4.6 (1.255)	4.892 (0.923)	4.453 (1.456)	4.371 (1.012)

For the dependent variable '*Risk perception*' the two-way ANOVA did not show a significant effect of the '*Chemical safety concerns*' ( $F(1,110) = 1.108, p=.295$ ), it did also not show a significant effect of '*Shelf life*' ( $F(1,110)=0.865, p=.354$ ). So, the chemical safety concern condition, as well as the shelf life condition had no significant effect on the risk perception of consumers. Neither was the interaction effect significant ( $F(1,110)=0.001, p=.980$ ).

For the dependent variable '*Benefit perception*' the two-way ANOVA did not show a

significant effect of '*Chemical safety concerns*' ( $F(1,110)=2.739, p=.101$ ), it did also not show a significant effect of '*Shelf life*' ( $F(1,110)=3.647, p=.059$ ) on benefit. So, the chemical safety concern condition, as well as the shelf life condition had no significant effect on the benefit perception of consumers. This means that hypothesis 5 (*Higher chemical safety concerns cause lower consumers' acceptance of active packaging*) cannot be confirmed. Neither was the interaction effect significant ( $F(1,110)=0.029, p=.866$ ).

For the dependent variable '*Acceptance*' the two-way ANOVA did not show a significant effect of '*Chemical safety concerns*' ( $F(1,110)=1.976, p=.163$ ), it did also not show a significant effect of '*Shelf life*' ( $F(1,110)=0.456, p=.501$ ). So, the chemical safety concern condition, as well as the shelf life condition had no significant effect on the acceptance of consumers. Hypothesis 4 (*Higher chemical safety concerns cause lower consumers' acceptance of active packaging*) cannot be confirmed. Neither was the interaction effect significant ( $F(1,110)=3.458, p=.066$ ).

For the dependent variable '*Attitude*' the two-way ANOVA did not show a significant effect of '*Chemical safety concerns*' ( $F(1,110)=2.275, p=.134$ ), it did also not show a significant effect of '*Shelf life*' ( $F(1,110)=0.228, p=.634$ ). So, the chemical safety concern condition, as well as the shelf life condition had no significant effect on the attitude of consumers. Neither was the interaction effect significant ( $F(1,110)=0.720, p=.398$ ).

It was shown that there is a negative correlation between risks and benefits ( $r=-0.278, p=.003$ ). This confirms hypothesis 3: *the perceived risks and benefits correlate negatively*.

To describe the relationship between set of independent variables '*Risk perception*' and '*Benefit perception*' and dependant variable '*Acceptance*'. A linear regression analysis was conducted with '*Acceptance*' as dependent variable and '*Risk perception*' and '*Benefit perception*' were used as independent variables. The two independent variables also explained a significant proportion in acceptance ( $R^2 = .261, F(2, 111) = 19.618, p < .05$ ). '*Risk perception*' has a significant effect on consumers' acceptance of active packaging ( $b = -.380, p < .05$ ), see table 2. Thus,

lower perceived risks results in a more consumers' acceptance of active packaging. This confirms hypothesis 1: *Higher perceived risks cause lower consumers' acceptance of active packaging*. 'Benefit perception' also has a significant effect on consumers' acceptance of active packaging ( $b = .298, p < .05$ ), see table 2. Thus, a higher perceived benefit results in a more consumers' acceptance of active packaging. This confirms hypothesis 2: *Higher perceived benefits cause higher consumers' acceptance of active packaging*.

<b>Table 2</b>	<b>Unstandardized B</b>	<b>SE</b>	<b>t (111)</b>	<b>p-value</b>
Risk perception	-.380	.087	-4.350	.000
Benefit perception	.298	.096	3.118	.002

The same linear regression analysis was also conducted with 'Attitude' as dependent variable. The two independent variables also explained a significant proportion in acceptance ( $R^2 = .358, F(2, 111) = 30.928, p < .05$ ). 'Risk perception' has a significant effect on consumers' attitude towards active packaging ( $b = -.369, p < .05$ ), see table 3. Thus, lower perceived risks results in a more positive attitude of active packaging. 'Benefit perception' also has a significant effect on consumers' attitude towards active packaging ( $b = .230, p < .05$ ), see table 3. Thus, a higher perceived benefit results in a more positive attitude of active packaging.

<b>Table 3</b>	<b>Unstandardized B</b>	<b>SE</b>	<b>t (111)</b>	<b>p-value</b>
Risk perception	-.369	.063	-5.892	.000
Benefit perception	.230	.069	3.363	.001

## **General conclusion and discussion**

The present research is consistent with the theory of Siegrist et al. (2005) that perceived risks and benefits have a significant effect on acceptance. The higher perceived risks/benefits of active packaging, the less/more likely it will be to accept by consumers.

Risks and benefits correlate with each other in a negatively, this is consistent with the theory of Gregory and Mendelsohn (1993). When active packaging is judged high in perceived benefits, it will be judged low in perceived risks and vice versa.

The four conditions did not differ significantly from each other. Both chemical safety concerns and the extension of the shelf life did not show a significant effect on perceived risks. This is also the case for the perceived benefits, the attitude and the acceptance of active packaging. This was not consistent with the stated hypotheses. The means of benefit perception, attitude and acceptance were the highest when respondents received information only about the extension of the shelf life. This was as expected, but the difference is not significant compared to other conditions.

### *Strengths, limitations and future research*

The present study has both some strengths and shortcomings that need to be recognised. A strength of the research is that the survey was filled in by people from ages between 16 and 68 ( $M_{age} = 28.26$   $SD_{age} = 13.56$ ), so opinions were conducted from people of all different ages. The outcome of the study is easier to generalise due to the widespread in ages. In addition, this is to my knowledge the first research that provides insight on consumers' acceptance of active packaging.

A shortcoming of the present research is that it only takes two variables into account that could influence the acceptance of active packaging, namely extension of the shelf life and the chemical safety concerns. In reality, there are much more variables which could influence the acceptance. Take environmental concerns as example: when a consumer is very environmentally conscious, the fact that active packaging helps with reducing food waste might increase the benefits they perceive towards active packaging. In addition, Siegrist (2008) has shown that people for whom naturalness of food is important perceive more risks associated with nanotechnology

compared to people for whom naturalness of foods is less important. Higher perceived risks influence the acceptance negatively (Siegrist et al., 2005). For future research it would be interesting to investigate the effect of more variables on the acceptance.

Furthermore, the fact that the conditions were not significantly different from each other could be due to weak manipulations. Long scenarios were avoided, because when a respondent would receive a very long text, it was expected that the text would not be read seriously. So, the scenarios were as short as possible. In addition, to keep the differences between the scenarios as small as possible, only little additional information about risks and benefits was given. With more additional information it could be possible that the differences between the manipulations was significant.

For future research it would be suggested to gain a higher number of respondents, in the present research were around thirty people in every condition. When looking at the p-values of the two-way ANOVA with '*benefit perception*' as dependent variable and '*chemical safety concerns*' and '*shelf life*' as independent variables, the p-values were close to significant. If more people had filled in the survey maybe this could benefit the level of significance. On the other hand, when looking at the p-values with '*risk perception*' as dependent variable, it is not expected that a larger sample would benefit the level of significance. This was not as expected, the condition with information about chemical safety concerns was stated that active substances could possibly be harmful for humans. If anything was expected to be significant, it was the risks perception. A reason for this could be that consumers expect products sold in the supermarket have minimal risks.

Another point of discussion is the difference between the  $R^2$  in the regression analysis with '*attitude*' and '*acceptance*' as dependent variables. The  $R^2$  with '*attitude*' as dependent variable was .358, whereas the  $R^2$  with '*acceptance*' as dependent variable only .261. This means that '*attitude*' explained almost 36% of the variance; '*acceptance*' only explained 26% of the variance. So, the measurement used for '*attitude*' is more precise. Future research should point out if this difference is due the fact that the two operationalisations were too different from each other.

To summarize, despite the fact that no significant differences were found between the conditions, the means of benefit perception, attitude and acceptance were the highest when respondents received information only about the extension of the shelf life. This is pointing to the direction as expected. In addition, this study adds additional support to previous findings about effects of risks and benefits on acceptance.

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## **Appendix**

Survey Flow

Block: introduction (1 Question)

BlockRandomizer: 1 - Evenly Present Elements

Standard: Only information about chemical safety concerns (2 Questions)

Standard: Only information about the extension of the shelf life (2 Questions)

Standard: Both information about extension of the shelf life and the chemical safety conce (2 Questions)

Standard: Control condition (2 Questions)

Block: Vragen (4 Questions)

Standard: demographics (2 Questions)

Standard: einde van de survey (2 Questions)

### **Survey questions**

Q1

Welkom!

Dankuwel voor het deelnemen aan dit onderzoek. Voor mijn bachelor thesis doe ik onderzoek naar de acceptatie van actieve verpakkingen onder consumenten. In de vragenlijst zal uitgelegd worden wat een actieve verpakking precies is, hierna krijgt u een aantal vragen.

Uw antwoorden zullen volledig vertrouwelijk en anoniem behandeld worden. Dit betekent dat uw antwoorden niet aan uw naam gelinkt zijn. Daarnaast is uw deelname vrijwillig en is het ook toegestaan ten alle tijden te stoppen met de vragenlijst. De vragenlijst zal ongeveer 5 minuten duren.

Voor meer informatie over deze studie, andere vragen of klachten, stuur alstublieft een mail naar [celine.vandentillaar@wur.nl](mailto:celine.vandentillaar@wur.nl)

Door te klikken op 'Ga door' geeft u aan dat u de bovenstaande tekst gelezen hebt en dat u tenminste 16 jaar oud bent.

Alvast bedankt voor uw hulp! U kunt nu beginnen aan de vragenlijst.

Gadoor (1)

Stop (2)

Start of Block: Only information about chemical safety concerns

Text Consumer 1

Op de volgende pagina zult u een korte informatie tekst krijgen over wat een actieve verpakking precies is. Lees deze tekst alstublieft nauwkeurig.

Text Consumer 2 Vers gesneden fruit kan naast traditionele verpakkingen tegenwoordig ook worden verpakt in actieve verpakkingen. In een actieve verpakking zijn actieve deeltjes aanwezig, deze zijn zo gemaakt dat ze samenwerken met de lucht in de verpakking of met het verpakte product. In tegenstelling tot traditionele verpakkingen, die deze actieve deeltjes niet bevatten, kunnen deze deeltjes de samenstelling van een product en de kenmerken ervan veranderen.

De actieve deeltjes zijn in contact met de lucht rondom het fruit, sommige van deze deeltjes zouden schadelijk kunnen zijn voor de mens. De precieze effecten zijn erg moeilijk te vinden doordat de actieve deeltjes heel erg klein zijn.

End of Block: Only information about chemical safety concerns

Start of Block: Only information about the extension of the shelf life

Text Retailer 1 Op de volgende pagina zult u een korte informatie tekst krijgen over wat een actieve verpakking precies is. Lees deze tekst alstublieft nauwkeurig.

Text Retailer 2 Vers gesneden fruit kan naast traditionele verpakkingen tegenwoordig ook worden verpakt in actieve verpakkingen. In een actieve verpakking zijn actieve deeltjes aanwezig, deze zijn zo gemaakt dat ze samenwerken met de lucht in de verpakking of met het verpakte product. In tegenstelling tot traditionele verpakkingen, die deze actieve deeltjes niet bevatten, kunnen deze deeltjes de samenstelling van een product en de kenmerken ervan veranderen.

De actieve deeltjes zorgen ervoor dat het fruit langer houdbaar blijft. Fruit kan langer geconsumeerd worden wat er voor zorgt dat er minder wordt verspild. De actieve

deeltjes zorgen er daarnaast voor dat de kans op groei van bacteriën en virussen beduidend kleiner is ten opzichte van traditionele verpakkingen. Dit komt de veiligheid van het fruit ten goede.

End of Block: Only information about the extension of the shelf life

Start of Block: Both information about extension of the shelf life and the chemical safety concern

Text Both 1 Op de volgende pagina zult u een korte informatie tekst krijgen over wat een actieve verpakking precies is. Lees deze tekst alstublieft nauwkeurig.

Text Both 2 Vers gesneden fruit kan naast traditionele verpakkingen tegenwoordig ook worden verpakt in actieve verpakkingen. In een actieve verpakking zijn actieve deeltjes aanwezig, deze zijn zo gemaakt dat ze samenwerken met de lucht in de verpakking of met het verpakte product. In tegenstelling tot traditionele verpakkingen, die deze actieve deeltjes niet bevatten, kunnen deze deeltjes de samenstelling van een product en de kenmerken ervan veranderen.

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De actieve deeltjes zijn in contact met de lucht rondom het fruit, sommige van deze actieve deeltjes zouden mogelijk schadelijk kunnen zijn voor de mens. De precieze effecten zijn erg moeilijk te vinden doordat de actieve deeltjes heel erg klein zijn.

End of Block: Both information about extension of the shelf life and the chemical safety concern

Start of Block: Control condition

Text No Pers. 1 Op de volgende pagina zult u een korte informatie tekst krijgen over wat een actieve verpakking precies is. Lees deze tekst alstublieft nauwkeurig.

Text No Pers. 2

Vers gesneden fruit kan naast traditionele verpakkingen tegenwoordig ook worden verpakt in actieve verpakkingen. In een actieve verpakking zijn actieve deeltjes

aanwezig, deze zijn zo gemaakt dat ze samenwerken met de lucht in de verpakking of met het verpakte product. In tegenstelling tot traditionele verpakkingen, die deze actieve deeltjes niet bevatten, kunnen deze deeltjes de samenstelling van een product en de kenmerken ervan veranderen.

End of Block: Control condition

Q24

De volgende vraag heeft betrekking op de risico's die u ervaart bij actieve verpakkingen.

De risico's die ik associeer met het gebruik van actieve verpakkingen zijn

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	(6)	(7)	
Erg laag	<input type="radio"/>	Erg hoog						

Q2. Voordelen

De volgende vraag heeft betrekking op de voordelen die u ervaart bij actieve verpakkingen.

De voordelen die ik associeer met het gebruik van actieve verpakkingen zijn

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	(6)	(7)	
Erg laag	<input type="radio"/>	Erg hoog						

Q19

De volgende vragen hebben betrekking hebben op uw acceptatie van actieve verpakkingen.

Denkt u dat de voordelen van actieve verpakkingen gelijk zijn aan de risico's ervan, denkt u dat de risico's zwaarder wegen dan de voordelen of denkt u dat de voordelen zwaarder wegen dan de risico's?'

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	(6)	(7)	
De risico's wegen zwaarder dan de voordelen	<input type="radio"/>	De voordelen wegen zwaarder dan de risico's						

Q20 Kies in hoeverre van de onderstaande woorden het best uw houding tegenover actieve verpakkingen omschrijft

	1 (1)	2 (2)	(3)	4 (3)	5 (4)	6 (5)	(7)	
Onrustig	<input type="radio"/>	Kalm						
Onveilig	<input type="radio"/>	Veilig						
Negatief	<input type="radio"/>	Positief						
Slecht	<input type="radio"/>	Goed						
Nadelig	<input type="radio"/>	Voordelig						
Angstig	<input type="radio"/>	Rustig						

Droevig



Blij

Q23 Wat is uw leeftijd?

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Q76 Wat is uw geslacht?

Man (1)

Vrouw (2)

Anders (3)

Q45

Bedankt voor uw deelname aan mijn onderzoek! Wanneer u nog opmerkingen heeft over de vragenlijst, of het onderzoek in het algemeen, kunt u hieronder een bericht typen. Als u een vraag stelt waar u graag antwoord op wilt laat u dan een e-mailadres achter waarop ik u kan bereiken.

Q44 U bent nu klaar met de survey. Bedankt voor uw deelname! Uw antwoorden zullen mij helpen om inzicht te krijgen in de acceptatie van actieve verpakkingen onder consumenten.

**Druk alstublieft op het pijltje om uw antwoorden te verzenden.**