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**Title of the manuscript:**

Consumers' preferences and their willingness to pay for juice with different packaging options in selected European countries

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**Abstract (50-100 words)**

Sustainable products are increasingly attractive to consumers due to rising crude oil prices and a growing environmental awareness. Against this background it has been analysed to what extent consumers living in Germany, the Netherlands and Sweden are willing to spend money for juice packed in a bioplastic bottle. In this context consumers' willingness to pay has been investigated by discrete choice experiments. By integrating other variables such as consumer attitudes or socio-demographics, respondents were characterized using latent class analyses showing that the highest willingness to pay for these products was found among participants with e.g. positive attitudes towards environmental protection and their own health.

**Key words:** Consumer survey, Europe, biomass-based consumer products, bioplastic packaging, discrete choice experiment, latent class analysis, willingness to pay measurement, marketing

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**Executive summary (250-300 words)**

Sustainable products are increasingly attractive to consumers due to rising crude oil prices and a growing environmental awareness in the population. Against this background biomass-based consumer products are an interesting option. Since biomass-based products still have low market shares intensive market investigations are necessary to understand how consumers perceive and assess biomass-based products. In this context bioplastics achieve growing interests as a product group with high development potentials.

Against this background this manuscript focuses on a key aspect of consumer behaviour: consumers' willingness to pay. Concretely, it analyses whether consumers living in Germany, the Netherlands and Sweden are willing to spend their money for juice packed in a bottle made of biomass.

Based on a survey (realized in 2008) in the three European countries, the consumers' willingness to pay for single product attributes (e.g. biomass-based plastic bottle) has been investigated by discrete choice experiments and was analysed by means of a multinomial logit model. Moreover, the questionnaire comprised important determinants of consumer behaviour, such as attitudes, knowledge or socio-demographics. With the aid of a multivariate statistical analysis method and the information given by the respondents it could be figured out that some consumers (or consumer segments) are willing to pay higher prices for biomass-based product attributes although the number of consumers paying price premiums is limited. Besides, compared with fruit content as another product attribute, packaging only plays a minor part. Nevertheless, using latent class analysis respondents with a higher willingness to pay for juice packed in a biomass-based plastic bottle can be characterised especially by positive attitudes towards environmental protection, their own health and living in the Netherlands.

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## **Introduction and problem statement**

In the last decades crude oil has contributed significantly to the global economic development and it still has an important function for industry, trade and private households. However, it has a number of important disadvantages. Issues like boosting CO<sub>2</sub>-emissions, environmental pollutions (e.g. sinking of the oil platform "Deepwater Horizon" in the Gulf of Mexico) and especially the (currently very strong) rising oil prices are to be mentioned which approach the record high of almost 150 \$ in 2008 (1)(2)(3)(4).

In the energy and transport sector a number of (regenerative) alternatives exist (e.g. wind, solar, geothermal or nuclear energy) for the substitution of crude oil. But for the production of goods, biomass-based raw materials (apart from recycling) are the only way to replace fossil-based products in the long term. One biomass-based product group with high substitution potentials are bioplastics of which new products, in particular attractive for private users, are steadily introduced in the European market (5)(6).

Nevertheless, biomass-based products have penetrated the markets only partially so far and still have only small market shares. Hence, they are still relatively unknown to consumers. In consequence, there exist only a small number of scientific studies dealing with biomass-based products focusing the consumers' perception. Moreover, this issue was hardly investigated comparing different European countries.

## **Objectives**

Against this background the objective of this paper is to analyse how consumers in selected European countries (Germany, the Netherlands and Sweden) perceive and assess biomass-based products or rather biomass-based product attributes.

Since the price of a product is one of the most important determinants of consumer behaviour (7) this manuscript focuses especially on the investigation of consumers' willingness to pay (WTP) for biomass-based product attributes.

A further goal is to identify and characterize consumers who are willing to pay the higher prices for biomass-based product attributes since these consumers should be addressed first when conducting marketing operations.

## **Brief overview about the procedure**

The manuscript on hand outlines the results of a research project ("BIOPOL") about biorefinery concepts which was funded by the European Commission since 2007 within the Sixth Framework Programme of Research. Thereby one part of the project was to analyse consumer perception towards biomass-based products.

Based on a survey in three European countries (Germany, the Netherlands and Sweden) realized in 2008 the paper-and-pencil questionnaire comprised questions about important activating and cognitive processes and information related to consumer behaviour, such as attitudes, knowledge or socio-demographics. The target of the survey was focused on consumers' evaluation and

perception of biomass-based product attributes. Therefore, the questionnaire also contained choice tasks to explore the preferences of the interview persons towards single product attributes (with the focus on biomass-based product attributes). These preferences and derived the willingness to pay for single product attributes (like e.g. a bioplastic packaging of juice) were analysed by means of a multinomial logit model within a discrete choice experiment (DCE). Based on the choices within the DCE respondents were classified in homogenous segments using a latent class analysis. Thereby relevant factors could be identified which influence the different groups. In the following the applied methods and the model are specified more accurately.

## Applied methods - discrete choice experiment and latent class analysis

Within the investigations described in this manuscript, a discrete choice experiment (DCE) was used. The choice for this method was made since it is possible by means of a DCE to measure the relevance of single product characteristics and to compare these with other characteristics. Thus, it is possible to assess the relative influence of each attribute and level on a product choice. In the specific case of the investigations on hand the consumers' preferences of single attributes of an orange juice are considered and analysed. Fruit juice (e.g. packed in a bioplastic bottle) was selected as examination object due to its familiarity in the three analysed countries.

In general discrete choice experiments base on two theoretical approaches. On the one hand it bases on the characteristics theory of products and on the other hand on the random utility theory (8)(9). Lancaster said that individuals do not derive satisfaction from a product itself but rather from the products' attributes (8). Moreover, the random utility theory assumes that an individual maximizes its utility when choosing between various product options (9)(10). The main assumption is that person  $q$  will choose alternative  $i$  if and only if:

$$U_{iq} > U_{jq} \text{ all } j \neq i \in A$$

A very popular and also the basic choice model to analyse a DCE is the conditional logit choice or rather the conditional multinomial logit model (MNL) (11), which bases on the following assumption:

$$P_i = \frac{1}{\sum_{j=1}^J \exp-(V_i - V_j)}; 1, \dots, i, \dots, J \quad i \neq j$$

By means of that formula one can calculate the probability of a person choosing a particular alternative  $i$  out of a set of  $J$  alternatives (9)(11).

By means of such logit models the willingness to pay (WTP) can be calculated. In the following the related formula is given whereas the  $\beta$ -coefficients of the single attribute levels were divided by the monetary item (12):

$$WTP_{\text{specific attribute}} = \beta_{\text{specific attribute}} / (-\beta_{\text{price}})$$

A very useful method to characterise interviewed persons within discrete choice experiments is a latent class analysis (LCA). The latent class analysis was originally introduced by Lazarsfeld,

who related observable variables to latent (that is to say non-observable) variables (13). In the 70ies, Goodman further refined the latent class method and complemented it (14)(15).

The LCA model is based on the assumption that every observation with a certain probability belongs to a specific distribution. The number of segments, their size and composition are unknown at the beginning. The LCA aims at dissecting the class-specific distribution and thus, at figuring out the size and composition of the latent segments (16). The objects are divided into clusters and segments and individuals (n) are classified in classes (s). By doing that, important marketing information or rather sales research information can be obtained to help identify consumer segments for example (17).

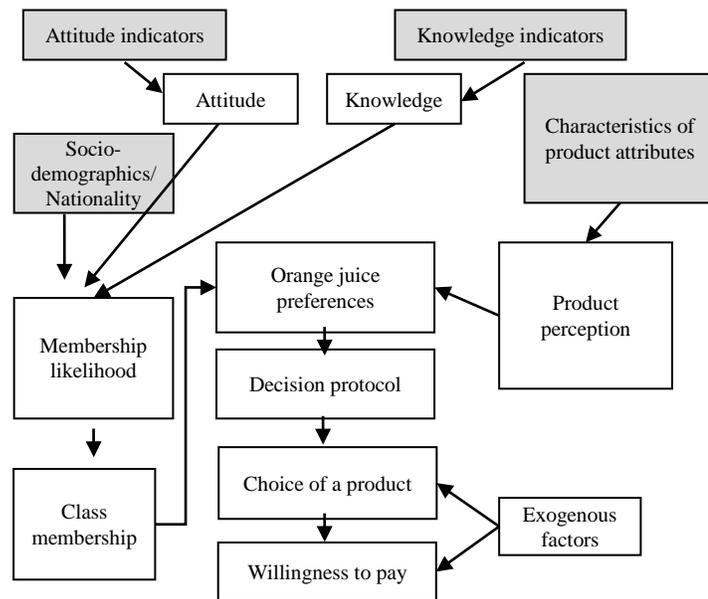
The number of segments has to be determined before the LCA can be estimated. There are a number of information criteria which help to identify the number of clusters. In this study, the statistics software “Latent Gold” by the company Statistical Innovations was used (18). This software calculates the information criteria in form of Akaike Information Criteria (AIC), Likelihood at convergence (LL), Bayesian Information Criteria (BIC), and consistent Bayesian Information Criteria (CAIC). Thus, these information criteria were taken into account in the empirical part of this survey.

The specialized scientific literature recommends starting to estimate the model with two segments and then increase the number successively. After having been estimated, the values of the individual model information criteria are compared with each other. The segment showing the smallest estimated values is probably the one with the best possible number of segments. According to Boxall (19) the number of segments can also be determined regardless of the values of the information criteria, if an additional segment or one segment less increases the power of interpretation. Thus, the researcher decides to what extend the chosen segment number is determined by using the information criteria (20). After determining the number of segments, the model is estimated and after considering the coefficient of the estimations, an interpretation follows (21). In the estimations of the latent class analysis, the corresponding algorithm maximizes both the homogeneity within and the heterogeneity between the segments (22).

## **Model of the latent class analysis**

A main goal of this work was to identify important characteristics of consumers which explain their preferences for orange juice. Specifically, these were attitudes (through assessment of statements), socio-demographics and nationalities which were considered as influencing variables. With respect to attitudes two items were set for 8 topic areas (like e.g. ecological, sustainable or economic issues) which could be assessed with a 5-divided Likert scale ranging from “I absolutely don’t agree” to “I strongly agree”. Furthermore, the knowledge of consumers towards certain biomass-based products was addressed in the questionnaire. Fig.1 depicts the factors relevant to the segment affiliation of the LC model for the examined orange juice. The grey variables are observable, while the white ones show non-observable or rather latent constructs. The observable variables are related to the latent variables and influence the membership of an individual to specific segments.

**Fig. 1: Determinants of segment membership in the LC model (own illustration modified according to (19)(21))**



As shown in Fig.1, the result of the models is the likelihood of choosing an orange juice from the available possibilities of orange juices. This provides the basis for the calculation of the willingness to pay for the corresponding product. Furthermore, exogenous factors such as out of stocks of a certain orange juice in shops or other market limitations or conditions could influence the choice and thus can influence the willingness to pay for the respective products (19)(21).

## Results

### Sample composition and additional descriptive results

After realising the data collection mid 2008 by means of paper-and-pencil interviews the information of 526 respondents from Germany (N=289), the Netherlands (N=111) and Sweden (N=126) could be considered for the data analysis. Thereby, the gender distribution of the sample was almost identical with census data of the surveyed countries. With respect to age, marital status, number of persons in household and income levels similar values could be identified. However, conceivably due to a relatively long questionnaire and the novelty of the examination object, the questionnaire was particularly filled in by higher educated people.

A specific focus of the survey was set to analyse the attitudes of the respondents by means of a Likert scale. Thereby two items were set for 8 topic areas with respect to ecological, sustainable, health, prestige and economic issues plus issues about imitation, variety seeking and consumer behaviour towards regional products. After performing a statistical analysis, especially the environmental, sustainable and health-related statements meet with high approval among the respondents. With respect to the remaining variables (in particular knowledge about biomass-based product groups) a specific level of knowledge could be detected amongst the respondents although it is limited. The attitude and knowledge variables were considered within the latent class analysis described below.

## **Preferences and willingness to pay for juice packed in a bioplastic bottle**

When using a discrete choice experiment (DCE), the relevance of single product characteristics can be measured and compared with other product characteristics. Some essential steps should be considered when conducting a DCE. The first one is the selection of a product. Hereby the choice for an orange juice is explained by the fact that it was assumed that the majority of consumers in the surveyed countries buy respectively consume fruit juice more or less regularly. Relevant attributes and their characteristics should be defined in a subsequent step within a DCE. For this investigation three attributes were considered, i.e. fruit content, price and packaging. Fruit content was chosen as it is a crucial attribute for consumers buying juice (23). Three levels of fruit content (20 %, 50 % and 100 %) were specified for this analysis. With respect to the prices, mean prices for orange juice were taken as anchor points in each country. Based on these average prices, two additional price levels were defined which range about 30 % above and below the average price resulting in e.g. 0.89 €/litre, 1.29 €/litre, and 1.69 €/litre in the Netherlands. Thereby, a negative interrelationship was assumed between the part worth utility of consumers and the different price levels. With respect to the fruit content a positive interrelationship was assumed, meaning that the higher the fruit content the higher is the part worth utility for consumers. Finally, the most common packaging materials in the surveyed countries (i.e. glass bottles and tetra pak cartons) were used for the third product attribute. In addition, a biomass-based plastic bottle was specified as the third type of packaging in order to fulfil the specific demands of this study.

The design of the survey was made on a manual basis. Hereby a profile method was adopted whereas all three attributes with its three levels were integrated in the design. Finally, 81 stimuli were created which were integrated in 27 choice-sets with three stimuli in each case. To avoid fatigue of interviewees resulting in a higher non-response rate, the 27 choice-sets were arranged in three questionnaires versions with 9 choice-sets each.

The choice sets were integrated in questionnaires. As a result, a total of 526 participants from the surveyed countries answered 4,599 choice sets resulting in a total of 13,797 observations which form the basis for the estimation of the multinomial logit model.

The statistical software “Stata/IC 10” was used to analyse the data. The results of the estimations are presented in Tab. 1 to Tab. 4 whereas Tetra Pak carton was used as reference level. Tab. 1 shows the results of all three countries together. In Tab. 2 to Tab. 4 results of the single countries are depicted. With respect to the statistical tests within the calculation of the multinomial logit model with all three countries the Pseudo  $R^2$  shows with 0.1683 an acceptable level. The same acceptable levels can be observed for the single countries, too. The likelihood-ratio tests revealed for all variables of the models statistically significant values at conventional significance levels. A further test comprises the Hausman-test (Independence of irrelevant alternatives (IIA)). The null hypothesis of this test could not be rejected and it can be assumed that the IIA of the single models were not injured.

**Tab. 1: Results of the discrete choice conditional multinomial logit model – Germany, the Netherlands and Sweden (own analysis)**

	<b>β-Coefficient</b>	<b>SE</b>	<b>z-value</b>	<b>P&gt; z </b>
<b>Biomass-based plastic bottle</b> <sup>1</sup>	0.7472	0.0492	15.20	0.000
<b>Glass bottle</b> <sup>1</sup>	0.1523	0.0502	3.03	0.002
<b>Price</b>	-2.1327	0.0849	-25.12	0.000
<b>Fruit content</b>	0.0371	0.0008	43.79	0.000

Observations: 13,797; Prob> chi<sup>2</sup>: 0.0000; Log likelihood = -6434.708; Pseudo-R<sup>2</sup>: 0.1683

<sup>1</sup>Reference level: Tetra Pak

**Tab. 2: Results of the discrete choice conditional multinomial logit model – Germany (own analysis)**

	<b>β-Coefficient</b>	<b>SE</b>	<b>z-value</b>	<b>P&gt; z </b>
<b>Biomass-based plastic bottle</b> <sup>1</sup>	0.5948	0.0662	8.99	0.000
<b>Glass bottle</b> <sup>1</sup>	0.4279	0.0668	6.40	0.000
<b>Price</b>	-2.3224	0.1261	-18.42	0.000
<b>Fruit content</b>	0.0381	0.0011	33.26	0.000

Observations: 7,776; Prob> chi<sup>2</sup>: 0.0000; Log likelihood = -3613.834; Pseudo-R<sup>2</sup>: 0.1674

<sup>1</sup>Reference level: Tetra Pak

**Tab. 3: Results of the discrete choice conditional multinomial logit model – the Netherlands (own analysis)**

	<b>β-Coefficient</b>	<b>SE</b>	<b>z-value</b>	<b>P&gt; z </b>
<b>Biomass-based plastic bottle</b> <sup>1</sup>	1.5412	0.1168	13.20	0.000
<b>Glass bottle</b> <sup>1</sup>	0.5122	0.1147	4.47	0.000
<b>Price</b>	-2.5951	0.2207	-11.76	0.000
<b>Fruit content</b>	0.0394	0.0019	20.26	0.000

Observations: 2,862; Prob> chi<sup>2</sup>: 0.0000; Log likelihood = -1266.1167; Pseudo-R<sup>2</sup>: 0.2140

<sup>1</sup>Reference level: Tetra Pak

**Tab. 4: Results of the discrete choice conditional multinomial logit model – Sweden (own analysis)**

	<b>β-Coefficient</b>	<b>SE</b>	<b>z-value</b>	<b>P&gt; z </b>
<b>Biomass-based plastic bottle</b> <sup>1</sup>	0.5070	0.0985	5.14	0.000
<b>Glass bottle</b> <sup>1</sup>	-0.8746	0.1101	7.94	0.000
<b>Price</b>	-1.9076	0.1446	-13.19	0.000
<b>Fruit content</b>	0.0377	0.0018	20.36	0.000

Observations: 3,159; Prob> chi<sup>2</sup>: 0.0000; Log likelihood = -1449.3156; Pseudo-R<sup>2</sup>: 0.1878

<sup>1</sup>Reference level: Tetra Pak

Regarding Tab. 1 - Tab. 4 the estimations of the logit model showed that the β-coefficients of fruit content were consistently positive meaning that the lower the fruit content the less likely interviewees are choosing the product. With respect to the prices, the β-coefficients of the price were negative in all estimations what can be expected according to economic theory. Regarding

the different packaging options, the tetra pak was used as reference level for the statistical estimations of the logit models. The results showed that the likelihood of choice is increased if the orange juice is packed in a biomass-based plastic bottle and decreased if it is packed in a tetra pak carton. However, Swedish consumers prefer juice in a tetra pak carton compared to a glass bottle (see Tab. 4). This preference may be explained by the fact that tetra pak cartons were originally developed in Sweden and were distributed by a Swedish company first. Nevertheless, consumers in all three countries prefer juice in a biomass-based plastic bottle.

By using the estimated  $\beta$ -coefficients of the logit models, the consumers' willingness-to-pay can be calculated for the varying product attributes and characteristics. This analysis showed that respondents from Germany, the Netherlands and Sweden are willing to pay on average about 35 eurocents more for juice in a biomass-based plastic bottle compared to juice in a tetra pak carton. The willingness to pay a price premium for glass bottles is clearly lower with an average of 0.07 € Using the data of the single countries, it could be figured out that consumers living in the Netherlands would accept the highest price premium for juice in a biomass-based plastic bottle.

Consumers' willingness to pay is distinctly higher with respect to the fruit content. The assumption of a linear relation between price and the different percentage-levels of fruit content results in a 52 eurocents higher WTP for a juice with 50 % fruit content compared to one with 20 %. Calculated with the same reference level the WTP for a juice with 100 % fruit content is even 1.22 € higher. Thus, the WTP for the product attribute packaging is rather moderate compared to the fruit content of the juice.

## Segmentation by means of a latent class analysis

A latent class analysis (LCA) was conducted in order to identify preference heterogeneity among consumers. The LCA is based on the assumption that each observation (N=462) belongs with a specific likelihood to a particular segment. Using the statistical software "Latent Gold" the LCA model for juice was estimated whereas the variables with significant or rather model-improving effects were integrated (21). The values of the information criteria „Log Likelihoods at convergence“ (LL), the "Akaike information criterion" (AIC), Bayesian information criterion (BIC) and the consistent Bayesian information criterion (CAIC) are listed in Tab. 5. In total, the estimations were conducted for 6 clusters.

**Tab. 5: Test statistics of different numbers of clusters in the latent class analysis (own analysis)**

Number of Clusters	LL	BIC (LL)	AIC (LL)	CAIC (LL)
1 Cluster	-3017.4896	6059.5473	6042.9792	6063.5473
2 Cluster	-2602.9555	5322.6096	5243.9109	5341.6096
3 Cluster	-2340.3900	4889.6093	4748.7801	4923.6093
4 Cluster	-2269.2719	4839.5036	4636.5438	4888.5036
5 Cluster	-2197.1269	4787.3442	4522.2538	4851.3442
6 Cluster	-2141.6217	4768.4644	4441.2434	4847.4644

Ideally, the number of segments in the LCA is optimal, if the values of the information criteria reach their lowest value. As depicted in Tab. 5, it was not possible to determine an adequate segment number solely taking into account these information criteria, since their values decrease

up to the 6 cluster solution. The number of segments was therefore determined by taking into account factual information as well. By doing so, a 4 cluster solution was chosen since the data are best described and interpreted in this way (24).

The results of the LCA with four segments are shown in Tab. 6. Thereby, only the significant factors (p-values <0.05 or 0.1) were taken into account and categorical variables were estimated effect coded.

**Tab. 6: Results of a 4 cluster latent class analysis (own analysis)**

	<b>Segment 1</b>		<b>Segment 2</b>		<b>Segment 3</b>		<b>Segment 4</b>		
<b>Name of the segment</b>	LOHAS		Prefer glass bottles & regional buyers		Prefer Tetra Pak and being egoists		Prefer biomass-based plastic bottles & unaware		
Size of the groups (n)	213 (46.1%)		127 (27.5%)		82 (17.8%)		40 (8.7%)		
<b>Importance of attribute (%)</b>									
Packaging	12.4		18.2		17.6		26.3		
Price	44.2		42.7		46.1		42.9		
Fruit content	43.4		39.2		36.3		30.8		
<b>Attributes</b>	Beta-Coef.	z-value	Beta-Coef.	z-value	Beta-Coef.	z-value	Beta-Coef.	z-value	p-value
<b>Packaging</b>									0.000
Biomass-based plastic bottle	1.779	14.535	-0.455	-4.787	-0.650	-4.867	2.017	10.174	
Tetra Pak	-0.709	-7.859	-0.943	-9.392	1.511	12.125	-1.246	-5.122	
Glass bottle	-1.070	-9.261	1.399	15.925	-0.862	-6.304	-0.771	-3.782	
<b>Price</b>									0.000
	-6.425	-13.003	-3.461	-9.326	-3.914	-9.540	-3.311	-5.562	
<b>Fruit content</b>									0.000
	0.124	15.987	0.063	19.328	0.061	14.678	0.047	8.250	
<b>Covariates</b>									
<b>Attitude towards environmental protection</b> („Protection of the environment is an important issue.“)									0.081
	0.583	2.486	-0.114	-0.437	0.204	0.769	-0.673	-1.624	
<b>Attitude towards sustainability</b> („The welfare of future generations is important to me.“)									0.039
	-0.314	-1.486	0.204	0.836	-0.593	-2.633	0.703	1.611	
<b>Attitude towards regional buying</b> („I mostly buy food which is produced in the region.“)									0.035
	0.003	0.031	0.318	2.786	-0.195	-1.506	-0.126	-0.718	
<b>Attitude towards health</b> („For the benefit of my health I eat fruit or vegetables at least three times every day.“)									0.051
	0.168	2.046	-0.131	-1.443	-0.111	-1.082	0.074	0.523	
<b>Level of knowledge</b> (scaled in below average, average and above average knowledge)									0.098
Below average knowledge	-0.583	-1.356	-0.345	-0.793	-0.325	-0.732	1.252	2.009	
Average knowledge	-0.357	-0.842	-0.456	-1.066	-0.449	-1.028	1.263	1.022	
Above average knowledge	0.940	2.133	0.801	0.962	0.774	0.918	-2.515	-1.024	
<b>Country</b>									0.000
Germany	-0.351	-2.540	0.497	3.129	0.254	1.334	-0.400	-1.722	
The Netherlands	0.320	1.978	0.447	2.294	-0.992	-3.594	0.225	0.922	
Sweden	0.031	0.198	-0.944	-4.357	0.738	3.565	0.175	0.728	

As depicted in Tab. 6 four segments were identified within the LCA. There were clear differences regarding the size of the identified segments: the first segment included 213 individuals what is nearly half (46.1 %) of all respondents. The second segment comprised 27.5 % (127) and the third 82 respondents (17.8 %). Segment 4 was clearly the smallest and included less than 10 % (40) of the respondents. The identified segments are described and named as follows:

#### Segment 1: LOHAS

Members of this segment prefer high fruit contents, have a positive attitude towards the environment and pay attention to their health. Therefore, this segment was named “LOHAS”. Although members of this group attach the lowest importance to the packaging of the juice they prefer the biomass-based plastic bottles compared to the other two alternatives. This further underlines the interest of this consumer segment in environmentally friendly and sustainable consumption patterns.

#### Segment 2: Prefer glass bottles & regional buyers

This group consists of consumers who prefer glass bottles as packaging option. Due to the fact that members of this group prefer relatively strongly regional products this segment was characterised by the keywords “Prefer glass bottles & regional buyers”. Especially Germans and Netherlanders seem to be members of this group.

#### Segment 3: Prefer Tetra Pak and being egoists

This segment is formed by consumers for whom the price has the highest importance compared to the other groups. Moreover, they show relatively high price sensitivity. In favour of Tetra Pak cartons they clearly reject biomass-based plastic bottles and glass bottles. In addition, a significant negative beta coefficient for sustainable aspects can be observed, resulting in the description “Prefer Tetra Pak and being egoists”.

#### Segment 4: Prefer biomass-based plastic bottles & unaware

This relative small group (8.7 %) consists of consumers for whom the packaging has the highest importance of all groups although it is still lower than price and fruit content. Since their members prefer the biomass-based plastic bottles and show a below average level of knowledge, this group was summarized with the keywords “Prefer biomass-based plastic bottles & unaware”.

In a final step of the analyses, the WTP for the different packaging options were calculated for the members of the identified consumer segments. This can be performed with the results of the LCA and the corresponding modal values. With 58 eurocents or 1.64 € respectively, members of the first (“LOHAS”) and fourth segment (“prefer biomass-based plastic bottles & unaware”) would pay the highest price premium for juice packed in a biomass-based plastic bottle. Regarding the other segments (“prefer glass bottles & regional buyers” and “prefer tetra pak & being egoists”), they showed the highest WTP either for glass bottles or for tetra pak cartons. Consequently, it is assumed that in particular members of the first and the fourth segment would be good target groups for introducing bioplastic bottles in the markets of the analysed countries.

## Discussion of the results

Due to the innovative character of the subject area under investigation, hardly any studies about biomass-based consumer products (in particular including international comparisons) could be found in the relevant scientific or marketing-related literature which hampered a direct comparison with the results of this survey. Thus the following comparison and review of literature refer to the small number of studies in which biomass-based (or rather eco-friendly) packaging of food is analysed.

One of the latest trends on the beverage or rather the packaging market reflects the wish of customers for an increasing greening of packaging (25). Already in 1999, PETERSEN et al. (26) described in a survey about the potential of biomass-based material for food packaging that European consumers attached a high importance to environmental aspects.

In an internationally oriented survey of the market research institute Nielsen conducted in 2008 (amongst others with the countries Germany, the Netherlands, and Sweden) the respondents said that environmentally friendly packaging became increasingly important. Almost half of the respondents said that they would be willing to avoid a certain type of packaging if this helped the environment (27)(28).

Additionally, the market research institute GfK estimated the willingness of consumers to pay 10 % higher prices for green packaging to about one of seven German respondents (29)(30). The results of GfK cannot be directly compared with the WTP results of fruit juice in a biomass-based plastic bottle as described in this manuscript, since the integration of the variable fruit juice content and the decision for a reference category makes it more sophisticated to calculate the percentage of consumers' willingness to pay higher prices. It can, however, be said that with regard to their preferred packaging the questioned consumers regarded the biomass-based plastic bottle as packaging with a (partly) high (environmental) benefit compared to the Tetra Pak and the glass bottle, which is reflected in their detected willingness to pay although it is limited.

In Lithuania, 700 respondents were asked about consumer awareness and their attitudes towards bio-degradable polymer packaging materials. Nine out of ten answered that they would support the introduction of this kind of food packaging material. In comparison with conventional packaging material, most respondents said that they are not willing to pay more than 5 % for green materials (31). Thus, also in Lithuania the price sets a limit with respect to the willingness to pay more. Although it may be assumed that there is a willingness to pay a (partially) higher price, but for the majority of the interviewed persons this willingness is, however, relatively low at 5 %.

Furthermore, a German study of 2002 dealing with recycling and renewable raw materials can be mentioned within this context. Consumer acceptance of degradable packaging, which consists totally or at least partly of biomass-based raw materials, was investigated in this study. A majority of the respondents answered that they would accept to pay a higher price for goods such as carrier bags or yoghurt pots made of degradable plastic, although the price sets an upper limit which only few consumers would be willing to pass (32).

Another study investigated the behaviour of Finnish consumers with respect to their preferences for "green" (recyclable) packaging materials. By means of a discrete choice experiment, part worth utilities of packaging material, brand, price and comfort of everyday products such as yoghurt drinks were determined. Besides the price, the packaging material was the most important product feature, whereby environmentally friendly packaging materials were clearly favoured. Furthermore, five consumer segments were identified with the cluster "green

packaging” counting the highest number of members. Members of this cluster are particularly characterised by their choice of environmentally friendly packaging (33).

The results of the Finnish study are similar to the findings of this survey according to which the test persons would prefer biomass-based or rather recyclable packaging materials. In contrast to the results from Finland and the findings of the survey described in this manuscript, a study of the market research institute AC Nielsen revealed that other packaging characteristics such as hygiene and freshness (characteristics that were neither taken into account in the Finnish study nor in the survey on hand) were regarded as more important than greenness. Consumers thought that greenness was important; however, greenness should not have a negative effect on the functionality of the packaging. Furthermore, consumers’ demands for environmentally friendly packaging do not necessarily bring about a greater willingness to pay more as identified in the context of this manuscript and the above mentioned surveys (25)(27)(28).

## **Summary and conclusions**

Summarising the results of the analyses depicted in this manuscript, it can be shown that there exist some consumers (or consumer segments) who are willing to pay higher prices for juice packed in a biomass-based plastic bottle although the number of these consumers is limited. These consumers express positive attitudes towards environmental protection and their own health. Within our sample, the highest percentage of such consumers is to be found in the Netherlands. Moreover, a very interesting finding of this survey is that, compared to other product attributes such as price or fruit content, packaging plays only a minor part and should not be overvalued within this context.

In conclusion, potential penetration effects of products with biomass-based product attributes will strongly depend on the number of consumers who are willing to accept and buy such products. But in times of rising crude oil prices and an increasing interest in “sustainable and ethically correct” consumption in the population of many European countries, biomass-based consumer products or products with biomass-based product attributes might have good opportunities winning an increased market share and to successfully compete with conventional products in the years to come.

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