

## ATTITUDE TOWARDS GMO IN LATVIA – RESULTS OF INHABITANT'S SURVEY

Inese Aleksejeva<sup>1</sup>, Mg. health and nutrition science, PhD student; Biruta Sloka<sup>2</sup>, Dr.oec., professor;

Inara Kantane<sup>3</sup>, Dr.admin., researcher, assistant prof.; Anastasija Vilcina<sup>4</sup>, Dr.oec., professor

<sup>1</sup> University of Latvia

<sup>2,3</sup> University of Latvia; University College of Economics and Culture

<sup>4</sup> Latvia University of Agriculture

**Abstract.** The aim of this paper is to analyse attitude of Latvia's inhabitants towards genetically modified organisms (GMO). Tasks of the current research: analysis of scientific publications; assessment of inhabitant's attitude towards genetic modified food, feed, pharmaceuticals and other GMO. Research methods applied: scientific publications studies, survey of inhabitants of Latvia. Survey questionnaire was designed based on the theoretical research results and experience of such research in other countries. The evaluation scale 1–10 was used for most of the aspects going to be evaluated in the survey to reflect better the attitude of consumers and to have a possibility make deeper statistical analysis of the survey results including use of multivariate statistical analysis. Descriptive statistics (indicators of central tendency or location and indicators of variability), cross tabulations, Mann-Whitney U test, Kruskal Wallis test were applied for survey data analysis. The empirical research results indicated that Latvia's inhabitants boost for the use of GMO was low. The inhabitants did not support at all or had little support for genetically modified (GM) animals, GM feed, GM crops resistant to herbicides, GM resistant to pests, GM crops with improved nutritional values, GM crops resistant to diseases and viruses.

**Key words:** attitude to GMO, consumers, inhabitants, survey.

**JEL code:** D81, I18, O31, Q18, M30

### Introduction

Attitude towards GMO has been discussed on different levels: policy makers, scientists, mass media and public. The regulations adopted in the European Union are very precautious towards GMO but in some countries of the world, including the USA the support for GM food, feed and pharmaceuticals is higher. Researchers world-wide have made numerous research on GMO issues in almost all branches of the national economy. Research on consumer's attitude towards GMO is monitored by Eurobarometer on regular basis in all European countries.

The aim of this paper is to analyse attitude of inhabitants towards GMO in Latvia. Research methods applied: scientific publications' studies, survey of Latvia's inhabitants. The tasks for research are: to evaluate scientific publications related to consumer's attitude towards GMO; to evaluate Latvia's people attitude towards GMO in relation to food, feed, pharmaceuticals and compare the results of the survey by age groups and gender. The survey of Latvia's inhabitants was conducted from September 2014 to June 2015. It was used systematic sample to ensure a random sample approach telemarketing company inhabitant data base and made telephone calls to respondents with invitation to participate in the survey and giving instructions on participation in the survey. The questionnaire was designed especially for the

respective inhabitant's survey. The evaluation scale 1–10, where 1 – do not support at all; 10 – fully support was applied in questionnaire to evaluate the attitude of inhabitants. descriptive statistics (indicators of central tendency or location and indicators of variability or dispersion), cross tabulations, Mann-Whitney U test, Kruskal Wallis test were applied for survey data analysis.

#### Research results and discussion

Scientific publications on public attitude towards GMO are developed in many countries and related to all aspects of GMO in relation to consumers attitude and acceptance of genetically modified food in multi-country studies is published in extensive scientific monograph, edited by scientists from the USA and Italy (Evenson and Santaniello edit., 2006), research results on EU expert's attitude towards GMO (Aleksejeva, 2014), on determining group and individual concerns regarding genetic engineering (Frewer, et al., 1997), on consumer acceptance of transgenic crops (Frewer, et al., 1998). Scientific discussions are carried out also on issues of consumers knowledge level and influence of this knowledge on attitude towards genetically modified food (Cuite, et al., 2005) and on consumers attitude and policy makers (Baker and Burnham, 2001).

Multi-country assessment on consumer acceptance and willingness to pay for GM vegetable oil and salmon was performed by researchers from the USA, Japan,

Norway and Taiwan (Chern, et al., 2002), research on consumer's attitude towards labelled and unlabelled genetically modified food products (Soregaroli, et al., 2003); on applications of GMO for food (Brady and Brady, 2003); on consumers knowledge on GMO and choice of GMO (Noussair, et al., 2002); on consumers trust in new technologies including GMO (Roller, 2001); on how much the consumers trust in food selection and GMO across national cultures (Priest, et al., 2003). Research has been conducted to evaluate consumers attitude towards GMO for feed (Turkac, 2016). Extensive research on consumers' attitude towards GMO for pharmaceuticals was carried out in several countries and was published by publishers in many countries (Vázquez-Salat, 2013; Straub, 2002). Researchers have paid attention also to use of GMO for wine production (Plahuta, 2007; Pretorious, 2000).

American researchers have investigated and evaluated several aspects of labelling of GMO in the USA – how consumers want to see it done (Teisl, et al., 2003). There are many publications on performed comparative analysis on consumers' attitude towards GMO in different countries: in Italy (Bocaletti and Moro, 2000); in Italy and the USA (Harrison, et al., 2004); in Norway (Grimsrud, 2002); in Spain (Lujan and Todt, 2000); in Singapore (Subrahmanyam, et al., 2000) and in the USA (Hallman, et al., 2002).

Several research methods are used in scientific publications world-wide to measure consumer's attitude towards GMO and GM: indicators of central tendency or location, indicators of variability as well as regression analysis (Soregaroli, et al., 2003; Hossain and Onyango, 2004).

In research community the extensive scientific discussions are carried out on experimental investigation of consumer willingness to pay for non-GM foods when an organic option is present (Bernard, et al., 2006).

The European Commission performs extensive document publications and legislation updates on regular basis (European Commission, 2016).

The survey of Latvia's inhabitants was conducted from September 2014 to June 2015. In all regions of Latvia there were surveyed 1184 persons. The database of inhabitants was purchased from a telemarketing company. A mechanical sampling was applied for selection of respondents to guarantee random sampling – every twentieth inhabitant was selected and included in the sample. At first the respondents were called on the phone and invited to answer survey questionnaire questions. If the respondents did not fill in the questionnaire in two weeks, the respondents were called by phone once more and asked to do it; in total respondents were called three times. The response rate of survey was 23%.

Among inhabitants of Latvia support for the use of GMO was low. Most of the respondents did not support GM animals (characterised by arithmetic mean – 1.9, median 1, mode 1). Respondents have covered all possible evaluation options from 1 to 10 but most responses were given to the lowest evaluation 1 (characterised by mode), half of respondents gave evaluation 1 (characterised by median). The evaluations of respondents were homogenous (characterised by standard deviation – 1.995). The support for GM feed by respondents was also very low (arithmetic mean – 2.4, median 1, mode 1), GM crops resistant to herbicides (arithmetic mean – 2.8, median 1, mode 1), GM crops resistant to pests (arithmetic mean – 3.0, median 1, mode 1), GM crops with improved nutritional values (arithmetic mean – 3.2, median 1, mode 1), GM crops resistant to diseases and viruses (arithmetic mean – 3.2, median 1, mode 1). Slightly more respondents supported the pharmaceuticals obtained by GMO (arithmetic mean – 4.2, median 4, mode 1), the evaluations were not homogenous (characterised by standard deviation – 3.149). The main statistical indicators of evaluations by inhabitants of Latvia on attitudes toward GMO are reflected in Table 1.

Table 1

Statistical indicators of evaluations by Latvia inhabitants on attitudes towards GMO

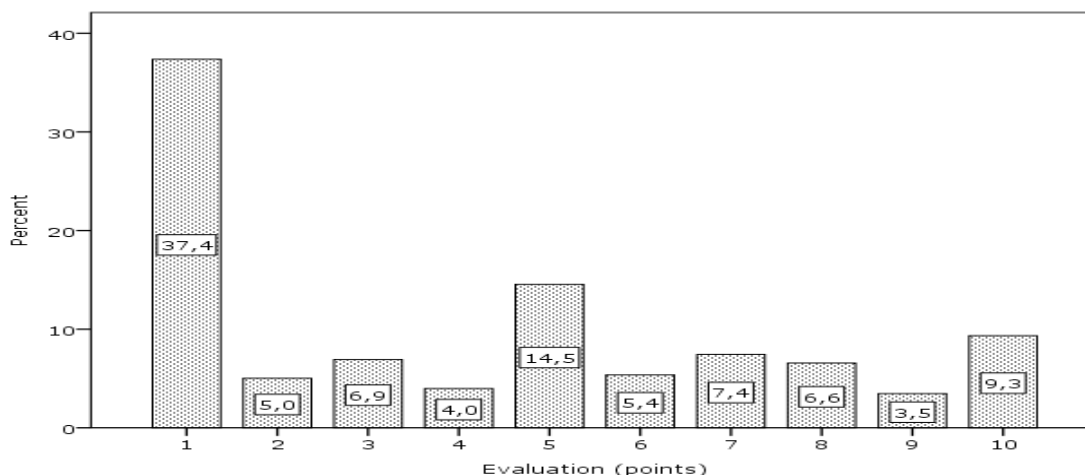
Statistical indicators	Pharmaceuticals obtained with GMO	GM crops with improved nutritional values	GM animals	GM feed	GM crops resistant to pests	GM crops resistant to herbicides	GM crops resistant to diseases and viruses
Mean	4.18	3.21	1.90	2.38	3.01	2.75	3.24
Std. error of mean	0.093	0.084	0.058	0.069	0.080	0.075	0.083
Median	4	1	1	1	1	1	2
Mode	1	1	1	1	1	1	1
Standard deviation	3.149	2.872	1.995	2.380	2.734	2.548	2.858
Range	9	9	9	9	9	9	9
Minimum	1	1	1	1	1	1	1
Maximum	10	10	10	10	10	10	10

Source: authors' calculations based on Latvia inhabitants survey conducted by Inese Aleksejeva, 2014 – 2015, n=1184, evaluation scale 1 – 10, where 1 – do not support at all; 10 – fully support

Results on consumer attitude towards GMO in Latvia indicated that about 37.4% of inhabitants in Latvia did not support the pharmaceuticals obtained with GMO, only about 9.3% of respondents had fully supported and about 17.5% of respondents had supported. The distributions of evaluations by inhabitants of Latvia towards GMO in pharmaceuticals are reflected in Figure 1.

GMO in food and in production of goods in different sectors of national economy. Male attitude toward GMO was more heterogeneous than female attitude (characterised by standard deviations). The main statistical indicators of evaluations on attitudes toward GMO by female and male in Latvia are reflected Table 2.

Although male respondent evaluations on support for GMO were low, the male respondents' comparatively more than female respondents supported the use of



Source: authors' calculations based on survey of inhabitants in Latvia conducted by Inese Aleksejeva, 2014 – 2015, n=1184, evaluation scale 1 – 10, where 1 – do not support at all; 10 – fully support

Fig. 1. Distribution of evaluations of inhabitants of Latvia on attitude toward the pharmaceuticals with GMO

Table 2

**Statistical indicators of evaluations by inhabitants of Latvia on attitude toward GMO by gender**

Use of GMO	Female				Male			
	Mean	Median	Mode	Standard deviation	Mean	Median	Mode	Standard deviation
Pharmaceuticals obtained with GMO	4.0	3	1	3.05	4.9	5	1	3.31
GM crops with improved nutritional values	2.9	1	1	2.71	3.9	3	1	3.20
GM animals	1.7	1	1	1.69	2.5	1	1	2.49
GM feed	2.0	1	1	2.02	3.2	1	1	2.95
GM crops resistant to pests	2.6	1	1	2.47	3.8	3	1	3.12
GM crops resistant to herbicides	2.3	1	1	2.27	3.5	2	1	2.90
GM crops resistant to diseases and viruses	2.9	1	1	2.64	4.0	3	1	3.16

Source: authors' calculations based on survey of inhabitants of Latvia conducted by Inese Aleksejeva, 2014 – 2015, n=1184, evaluation scale 1 – 10, where 1 – do not support at all; 10 – fully support

Table 3

**Average values of evaluations of inhabitants in Latvia on attitude toward GMO by age groups**

Use of GMO	Age groups									
	18-28		29-39		40-50		51-61		62 and more	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Pharmaceuticals obtained with GMO	4.87	5	3.92	3	4.34	4	3.87	3	3.57	2
GM crops with improved nutrition values	4.18	4	3.04	1	2.63	1	2.36	1	3.35	1
GM animals	2.39	1	1.61	1	1.80	1	1.63	1	2.30	1
GM feed	2.97	1	2.07	1	2.23	1	2.04	1	2.61	1
GM crops resistant to pests	3.93	3	2.51	1	2.82	1	2.44	1	2.78	1
GM crops resistant to herbicides	3.47	2	2.29	1	2.40	1	2.44	1	3.00	1
GM crops resistant to diseases and viruses	4.25	4	2.79	1	2.86	1	2.55	1	3.61	2

Source: authors' calculations based on survey of inhabitants of Latvia conducted by Inese Aleksejeva, 2014 – 2015, n=1184, evaluation scale 1 – 10, where 1 – do not support at all; 10 – fully support

The differences in the female and male attitude toward pharmaceuticals obtained with GMO, GM crops with improved nutritional values, GM animals, GM feed, GM crops resistant to pests, GM crops resistant to

herbicides, GM crops resistant to diseases and viruses were statistically significant with high probability as proved by the results of the Mann-Whitney U test ( $z = -3.893$ ,  $p=0.000$ ;  $z = -4.795$ ,  $p=0.000$ ;  $z = -5.722$ ,  $p=0.000$ ;  $z = -6.185$ ,  $p=0.000$ ;  $z = -5.994$ ,  $p=0.000$ ;  $z = -6.793$ ,  $p=0.000$ ;  $z = -5.466$ ,  $p=0.000$ , respectively).

Young people (age 18-28) comparatively more supported the use of GMO in food and products created by GMO in different sectors of national economy. Young people's (age 18-28) attitude toward pharmaceuticals obtained with GMO was – medium support (characterised by arithmetic mean 4.97 and by median 5 – it means that half of respondents from this age group gave evaluations 5 or less) but older people attitude was – medium lack of support (characterised by arithmetic mean 3.57 and by median 2). Young people had higher evaluation for use of GMO for all evaluated aspects included in analysis.

The average values (arithmetic mean and median) of evaluations of inhabitants of Latvia on attitude toward GMO by age groups are reflected in Table 3.

The differences in attitude toward the use of GMO by age groups were statistically significant with high probability as proved by the results of the Kruskal Wallis test ( $p=0.000$ ). The attitude toward pharmaceuticals obtained with GMO differed statistically significant between the people aged 18-28 years and older people ( $p<0.005$ ). The attitude toward GM crops with improved nutritional values differed statistically significant between the people aged 18-28 years and older ( $p<0.019$ ). The attitudes toward GM animals, toward GM feed, GM crops resistant to herbicides, GM crops resistant to diseases and viruses differed statistically significant between the people aged 18-28 years and older ( $p<0.001$ ), except respondents aged 62 years and more. The attitude toward GM crops resistant to pests differed statistically significant between the people aged 18-28 years and older ( $p<0.004$ ).

Further analysis on survey results is going on by use of multivariate statistics.

### **Conclusions, proposals, recommendations**

1) Support for the use of GMO by inhabitants of Latvia was low. Most respondents did not support genetically modified animals, the evaluations of respondents were homogenous.

2) The support for genetically modified feed by Latvia's inhabitants was also very low.

3) Slightly more respondents supported the pharmaceuticals obtained with GMO but the evaluations by respondents were not homogenous.

4) Although male respondent evaluations on support for GMO were low, the male respondents' comparatively more than female respondents supported the use of GMO in food and in production of goods in different sectors of national economy comparatively more than female respondents. Male attitude toward GMO was more heterogeneous than female attitude.

5) The differences in the female and male attitude toward GMO (the pharmaceuticals obtained with GMO, GM crops with improved nutritional values, GM animals, GM feed, GM crops resistant to pests, GM crops resistant to herbicides, GM crops resistant to diseases and viruses) were statistically significant with high probability as proved by the results of the Mann-Whitney U test.

6) Young people (age 18-28) comparatively more supported the use of GMO in food and in products produced in different sectors of economy. Young people (age 18 to 28) attitude toward the pharmaceuticals obtained with GMO was – medium support but older people attitude was – medium lack of support. Young people had higher evaluations on GMO in different fields of national economy.

7) The differences in attitude toward use of GMO by age groups were statistically significant with high probability as proved by the results of the Kruskal Wallis test.

8) The attitude toward the pharmaceuticals obtained with GMO differed statistically significant between the people aged 18-28 years and older people.

9) The attitude toward GM crops with improved nutritional values differed statistically significant between the people aged 18-28 years and older.

10) The attitude toward GM animals, toward GM feed, GM crops resistant to herbicides, GM crops resistant to diseases and viruses differed statistically significant between the people aged 18-28 years and older, except age group of inhabitants of 62 years and more.

11) The attitude toward GM crops resistant to pests differed statistically significant between the people aged 18-28 years and older.

## Bibliography

1. Aleksejeva, I. (2014). EU Experts' Attitude towards Use of GMO in Food and Feed and Other Industries. *Procedia - Social and Behavioral Sciences*, Volume 110, pp. 494 – 501.
2. Baker, G.A., Burnham, T.A. (2001). Consumer Response to Genetically Modified Foods: Market Segment Analysis and Implications for Producers and Policy Makers. *Journal of Agricultural and Resource Economics*, Volume 26, Issue 2, pp. 387-403.
3. Bernard, J.C., Zhang, C., Gifford, K. (2006). An Experimental Investigation of Consumer Willingness to Pay for Non-GM Foods When an Organic Option Is Present. *Agricultural and Resource Economics Review*. Volume 35, Issue 2, pp. 374–385.
4. Boccaletti, S., Moro, D. (2000). Consumer Willingness to Pay for GM Food Products in Italy. *AgBioForum*, Volume 3, Issue 4, pp. 259-267.
5. Brady, J.T., Brady, P.L. (2003). Consumers and Genetically Modified Foods. *Journal of Family and Consumers Sciences*. Volume 95, pp. 12-18.
6. Chern, W.S., Rickertsen, K., Tsuboi, N., Fu, T.-T. (2002). Consumer Acceptance and Willingness to Pay for Genetically Modified Vegetable Oil and Salmon: A Multiple-Country Assessment. *AgBioForum*, Volume 5, Issue 3, pp. 105-112.
7. Cuite, C.L., Aquino, H.L., Hallman, W.K. (2005). An Empirical Investigation of the Role of Knowledge in Public Opinion about GM Food. *International Journal of Biotechnology*, Volume 7, Issue 1-3, pp. 178-194.
8. Frewer, L.J., Hedderley, D., Howard, C., Shepherd, R. (1997). 'Objection' Mapping in Determining Group and Individual Concerns Regarding Genetic Engineering. *Agriculture and Human Values*, Volume 14, Issue 1, pp. 67-79.
9. Frewer, L.J., Howard, C., Aaron, J.I. (1998). Consumer Acceptance of Transgenic Crops. *Pesticide Science*, Volume 52, Issue 4, pp. 388-393.
10. Grimsrud, K., McCluskey, J., Loureiro, M., Wahl, T. (2002). Consumer Attitudes Toward Genetically Modified Food in Norway. *Journal of Agricultural Economics*, Volume 55, Issue 1, pp. 75 -90.
11. Hallman, W.K., Adelaja, A.O., Schilling, B.J., Lang, J. (2002). Public Perceptions of Genetically Modified Foods: Americans Know not What They Eat. Publication No. RR- 0302-001, Food Policy Institute, Rutgers University. A Food Policy Institute Publication, New Brunswick, NJ, pp. 1-62.
12. Harisson, J.W., Boccaletti, S., House, L. (2004). Risk Perceptions of Urban Italian and United States Consumers for Genetically Modified Foods. *AgBioForum*, Volume 7, Issue 4, pp. 195-201.
13. Hossain, F., Onyango, B. (2004). Acceptance of Genetically Modified Foods. *International Journal of Consumer Studies*, Volume 28, Issue 3, pp. 255-267.
14. European Commission (2016). Genetically Modified Organisms – official webpage of EC. Retrieved: [http://ec.europa.eu/food/plant/gmo/index\\_en.htm](http://ec.europa.eu/food/plant/gmo/index_en.htm). Access: 04.01.2016.
15. Evenson, R.E., Santaniello, V. edit. (2006). Consumer Acceptance of Genetically Modified Foods. CABI Publishing. 245 p.
16. Lujan, J.L., Todt, O. (2000). Perceptions, Attitudes and Ethical Valuations: The Ambivalence of the Public Image of Biotechnology in Spain. *Public Understanding of Science*, Volume 9, Issue 4, pp. 383-392.
17. Noussair, C., Robin, S., Ruffieux, B. (2002). Do Consumers not Care about Biotech Foods or do they Just not Read the Labels? *Economics Letters*, Volume 75, Issue 1, pp. 47-53.
18. Plahuta, P., Tivadar, B., Raspor, P. (2007). Slovenian Public Opinion Regarding Genetically Modified Organisms in Winemaking. *Acta Alimentaria*, Volume 36, Issue 1, pp. 61-73.
19. Pretorius, I.S. (2000). Tailoring Wine Yeast for the New Millennium: Novel Approaches to the Ancient Art of Winemaking. *Yeast*, Volume 16, Issue 8, pp. 675-729.
20. Priest, S.H., Bonfadelli, H., Rusanen, M. (2003). The "Trust Gap" Hypothesis: Predicting Support for Biotechnology across National Cultures as a Function of Trust in Actors. *Risk Analysis*, Volume 23, Issue 4, pp. 751-766.
21. Roller, S. (2001). Genetically Modified Foods: Threat or Opportunity? *Food Technology and Biotechnology*, Volume 39, Issue 4, pp. 259-263.
22. Soregaroli, C., Boccaletti, S., Moro, D. (2003). Consumer's Attitude towards Labelled and Unlabelled GM Food Products in Italy. *International Food and Agribusiness Management Review*. Volume 6, Issue 2, pp. 111 – 127.
23. Straub, J.O. (2002). Environmental Risk Assessment for New Human Pharmaceuticals in the European Union According to the Draft Guideline/Discussion Paper of January 2001. *Toxicology Letters*, Volume 135, Issue 3, pp. 231-237.
24. Subrahmanyam, S., Cheng, P.S. (2000). Perceptions and Attitudes of Singaporeans toward Genetically Modified Food. *Journal of Consumer Affairs*, Volume 34, Issue 2, pp. 269-290.
25. Teisl, M.f, Garner, L., Brian R., Vayda, M.E. (2003). Labelling Genetically Modified Foods: How Do US Consumers Want to See It Done? *AgBioForum*, Volume 6, Issue 1&2, pp. 48-54.
26. Turkec, A., Lucas, S.J., Karacanli, B., Baykut, A. Yuksel, H. (2016). Assessment of a Direct Hybridization Microarray Strategy for Comprehensive Monitoring of Genetically Modified Organisms (GMOs). *Food Chemistry*, Volume 194, Volume 1, pp. 399-409.
27. Vazquez-Salat, N. (2013). Are Good Ideas Enough? The Impact of Socio-Economic and Regulatory Factors on GMO Commercialisation. *Biological Research*, Volume 46, Issue 4, pp. 317-322.

The paper was supported by the National Research Programme 5.2. EKOSOC-LV