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Pesticides and integrated crop management (IPM) food products Factors affecting their acceptance by consumers

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ABSTRACT

The forthcoming changes in the Common Agricultural Policy of the EU are expected to accrue changes to agricultural food products, in terms of pesticide use and food certification. Knowledge of the factors that affect consumer perceptions of certified Integrated Crop Management (ICM) food is imperative to making targeted interventions or taking corrective actions in the future. For this purpose, in the spring of 2021, a survey was conducted in Greece with 1,846 participants. Exploratory factor analysis was applied to the questionnaire variables, followed by binomial logistic regression analysis regarding the research question: If the participants consider that ICM food products are safe or not, in terms of the presence of pesticide residues. Among the participants, the likelihood to express a positive attitude towards the research question was greater among those who trust food certification, those who get informed about pesticides from specialized information sources, who are male, those who positively perceive the contribution of pesticides and finally, the older aged participants (> 45 years old). The results indicate that consumers consider ICM food products to be safe and acceptable in terms of pesticide use issues. Trust in labelling, traceability and certification procedures is the key factor in accepting ICM products. It also appears that specialized information sources on pesticides (bulletins of public bodies, official websites, agronomists, scientific journals) play a key role in shaping consumer views. Measures should be taken by official bodies for targeted consumer information on pesticides and food safety through general information sources and social networks.

KEY WORDS: Consumer's attitudes, pesticide residues, factor analysis, logistic regression, European Green Deal, integrated crop management.

Introduction

It is a common practice in many areas of agriculture to use pesticides in an effort to increase production and improve quality of the final product (Damalas and Eleftherohorinos, 2011). Cooper and Dobson (2007) undertook a comprehensive analysis of the positive effects of pesticide use and concluded that, when applied properly, pesticides improve our quality of life. Pre- and post-harvest losses negatively impact poverty and malnutrition (Gustavsson et al., 2011; de Bon et al., 2014), making the prevention of these losses one of the most prominent contributions of agrochemical use (Savary et al., 2012, 2019; Sharma et al., 2017).

The risk to public health from dietary exposure to pesticide residues is debated

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due to the difficulty in assessing the significance of their presence in food (Magkos et al., 2006; Damalas and Eleftherohorinos, 2011). Numerous studies have demonstrated that pesticide residues in foods pose a threat to public health (Bolognesi and Morasso, 2000; Tago et al., 2014; Nicolopoulou-Stamati et al., 2016). According to Bourguet and Guillemaud (2016), the costs associated with using pesticides have outweighed the benefits. However, concerns have been raised that few pesticide-related health effects can be classified as causal (Tago et al., 2014). Furthermore, the simultaneous presence of multiple pesticide residues in food has been a cause for concern (Kortenkamp, 2007). Nevertheless, the European Food Safety Authority has concluded, with varying degrees of certainty, that the cumulative dietary exposure does not meet the threshold for regulatory consideration in all European countries following the recently published retrospective cumulative risk assessments of dietary exposure to residues in 2014, 2015 and 2016 of pesticides with acute effects on the nervous system (EFSA et al., 2020a) and chronic effects on the thyroid (EFSA et al., 2020b). Compared to the previous reference period, exposure to pesticides that have chronic effects on the thyroid and exposure to pesticides that have acute effects on the nervous system did not change significantly in 2016-2018 (EFSA and Dujardin, 2021).

There is still considerable uncertainty in research on the health effects of pesticides, and the public has limited access to credible information on pesticides and health (Tago et al., 2014). In addition, the role of pesticides in sustainable food production is rarely discussed in public (Atreya, 2000). It is therefore inevitable that pesticide residues in food will generate high levels of perceived threat (Whaley and Tucker, 2004; Hohl and Gaskell, 2008). Simoglou and Roditakis (2022) showed that the Greek public is extremely concerned about pesticide residues in food, both for the health of their families as well as their own, even though they acknowledge that pesticide use contributes significantly to food security and the national economy. According to Harris et al. (2001), consumers' perceptions of the risk posed by pesticide residues have always been influenced by emotional input, which may account for any exaggeration of new information (Tago et al., 2014). Food risk perception is most often influenced by cognitive processing of information provided by third parties and considerations of the individual's condition (Ueland et al., 2012).

Consumer perspectives on food safety vary according to socio-demographic variables (Wilcock et al., 2004). The absence of pesticide residues in fruit and vegetables purchased by Greek consumers was shown to be a key factor by Karagianni et al (2003). Females and those familiar with the HACCP certification system were found to be more concerned about chemical residues. There is also evidence of a high willingness to buy certified fruits and vegetables (Krystallis et al., 2007). Greek consumers who are concerned about chemical residues in food are more likely to buy organic products (Tsakiridou et al., 2006; 2008). In addition, it has been shown that both the attitude towards consuming safer food and the application of traceability, influence the willingness of Greek consumers to purchase certified food (Krystallis and Chryssohoidis, 2005; Botonaki et al., 2006; Tsakiridou et al., 2009; 2011). Labelling is particularly important as a means to help consumers assess the quality of food products (Dimara and Skuras, 2005; Tsakiridou et al., 2012). Consumer acceptance of traceability systems acts as a catalyst for stakeholder adoption (Anastasiadis et al. 2022). Confidence in certification procedures for plant foods is a significant predictor of Greek consumers' benefit-risk perceptions

of pesticide use, according to Simoglou and Roditakis (2022). This confidence arises from the significance of traceability and label information for plant-based foods to consumers, as well as the sense of security provided by certification, particularly for products certified under Integrated Crop Management (ICM).

Improving the sustainability of the EU food supply chain "from farm to fork" is at the core of the European Green Deal. One of the primary goals of this fundamental transition in EU food and agriculture policy is to reduce the use and risk of chemical pesticides by 50% by 2030 (Schebesta and Candel, 2020; European Commission, 2023). This ambitious goal aims to protect human health and the environment while promoting sustainable farming practices. Achieving this will require a concerted effort by all stakeholders, including farmers, policy makers, researchers and consumers (Peeters et al. 2021). Public opinion is often overlooked when it comes to agroecological food production systems, despite its importance. In the context of ICM, there is a need to better understand public attitudes towards pesticide residues and food safety. This study aimed to improve our understanding of Greek consumers' beliefs about the safety of ICM food products in terms of the presence of pesticide residues, an area where information on public perceptions is limited, and to identify the predictor variables associated with personal attitudes and views, as well as socio-economic factors that may influence them.

Materials and Methods

The study was conducted through a web-based survey. The data collection was facilitated by the use of a questionnaire posted on Google Forms platform. The survey questionnaire was sent by email, Viber and Facebook's Messenger applications to approximately 9,100 recipients, while it was also disseminated by articles in online news fora and magazines. Through the duration of the survey, 1,846 completed questionnaires were obtained. On the question of the safety of ICM foods regarding the presence of pesticide residues, there is no previous study based on a large national sample of Greek population attitudes.

The survey, undertaken between 6th March and 31st March 2021, aimed to investigate the beliefs, perceptions and feelings of the general consumers' audience on ICM food products in relation to pesticide residues and food safety, in Greece. The questionnaire was divided into two sections: a) socio-demographics and b) attitudes.

The questionnaire included 5-point Likert-scale closed questions, as regards their perceptions or attitudes. The response levels for Likert scale were: 1 = totally disagree, 2 = partly disagree, 3 = neither disagree/nor agree, 4 = partly agree, 5 = totally agree, or, 1 = never, 2 = rarely, 3 = occasionally, 4 = frequently, 5 = habitually, depending on the case.

Data collected from the questionnaires were initially subjected to descriptive statistical analysis. The median was used as the appropriate central tendency measure to present and interpret the results of the questionnaire, following Simoglou and Roditakis (2022).

Exploratory factor analysis (FA) was conducted to identify the underlying construct among variables, and to summarize information contained in variables into a reduced set of composite factors that represent dimensions within data. As a cut-off for the number of retained factors, the eigenvalue criterion of greater than one (1) was used. Following oblique (promax) rotation, the rotated loadings exhibited a significantly more simplified factor-loading pattern, with each variable loading

(correlating) to a single factor. In the final analysis, only variables with loadings greater than or equal to 0.50 were retained. The appropriateness of FA was evaluated using the Kaiser-Meyer-Olkin (KMO) test, which takes values between 0 and 1 as a measure of sampling adequacy, and the Barttlets's test of sphericity, where a significant result indicates that at least some pairwise correlations among variables are not equal to zero (Navarro et al., 2018; Hair, 2019).

It was determined and reported the McDonald's ω reliability coefficient of internal consistency for the scale variables (Hayes and Coutts, 2020). For further analysis, variables loading on a single factor were combined using composite scores to obtain a single measure of each factor (Hair, 2019).

The question of participants' perceptions of the safety of ICM food products were used as the dependent variable for a binary logistic regression to identify any potential predictors. The model included sociodemographic variables and factors retained from the FA as potential predictors. Calculated and presented were odds ratios (OR) and 95% confidence intervals (CI). Each of the model's independent variables was subjected to the Wald test of statistical significance. Last but not least, performance metrics such as specificity and sensitivity, which represent the proportions of true negative and true positive observations predicted by the model, respectively, as well as AUC (area under the ROC curve depicting the trade-off between true positive rate and false positive rate), which is an overall test of predictive accuracy and indicates the amount of discrimination between true positive and false positive values of the estimated model, were calculated. Large AUC values (> 0.5 - 1) indicate a superior model fit (Hair, 2019).

For the purpose of logistic regression analysis, participants' opinion variables were split into two levels with a binary outcome: "favour" = 1, after grouping the Likert response levels "partly agree" and 'totally agree", and "disfavour" = 0, after grouping the Likert response levels "totally disagree", "partly disagree" and "neither disagree nor agree", following Simoglou and Roditakis (2022).

The open-source statistical analysis software Jasp (0.17.2) (JASP Team, 2023) was used for analyses.

Results

Characteristics of Survey Participants

A total of 1,846 participants from all regions of Greece completed the questionnaire. The study population consisted of plant-based food consumers aged between 18 and 65 years living in urban and rural areas throughout Greece (mainland and islands). The socio-demographic characteristics of the survey participants are shown in Table 1.

Consumer perceptions of the safety of ICM plant-food products

The frequency distribution of participants' replies to the question under investigation, concerning their views about whether or not the plant-food products produced under integrated crop management principles are safe regarding pesticide residues, was obtained as follows: Totally disagree (med. = 1): N = 59 (3.20%); partly disagree (med. = 2): N = 156 (8.45%); neither disagree/nor agree (med. = 3): N = 357 (19.34%); partly agree (med. = 4): N = 890 (48.21%); totally agree (med. = 5): N = 354 (20.80%). The median of the replies' distribution is equal to 4 (IQR: 1), which implies partial agreement to the statement in central

tendency terms. In fact, a significantly higher proportion of favorable responses were found, tested against the null hypothesis that the two categories are equally likely ($p = 0.50$). After splitting the response rates into two levels with a binary outcome, i.e. "favor" and "disfavor", a binomial proportion test was applied. The proportion of "favor" replies was 0.690 (CI: 0.668 – 0.711), N = 1274 and the corresponding proportion of "disfavor" responses was 0.310 (CI: 0.289– 0.332), N = 572 ($p < 0.01$).

TABLE 1. Sociodemographic characteristics of the respondents (N = 1,846)

Demographic variables		Frequency	Percentage
Gender	Female	896	48.5%
	Male	950	51.5%
Age	18 – 24	220	11.9%
	25 – 34	195	10.6%
	35 – 44	404	21.9%
	45 – 54	669	36.2%
	55 – 64	304	16.5%
	≥ 65	54	2.9%
Education level	Less than high school	31	1.7%
	High school – Technical education	397	21.5%
	Bachelor's degree	727	39.4%
	Master's degree	565	30.6%
	Doctoral degree	126	6.8%
Population of place of residence	Less than 10,000 inhabitants	468	25.4%
	More than 10,000 inhabitants	1378	74.6%
Profession	Civil servants	814	44.1%
	Private employees	344	18.6%
	Self-employed	224	12.1%
	Farmers	98	5.3%
	Unemployed	71	3.9%
	University students	215	11.7%
	Retired	80	4.3%

Factors underlying the participants' attitudes

An exploratory factor analysis was performed to identify the structure of relationships among variables of the original data. Seventeen original variables were analyzed having loadings greater than 0.50. Five factors were retained, having substantial amounts of common variance and considered appropriate to adequately represent the underlying structure in the data (Table 2). The explained cumulative variance was 54.3%. Reliability coefficients (McDonald's ω) varied between 0.715 and 0.862. All factors had sum of the squared loadings (eigenvalues) greater than 1.0. Both Bartlett's test of sphericity ($p < 0.001$) and the KMO Measure of Sampling Adequacy (0.793) suggested suitability of the correlation matrix for a principal components analysis.

The first factor, which consists of four variables and accounts for 15.5% of the total variance, summarizes variables representing "Specialized information sources" used by participants to learn about pesticides. As sources of information, official websites, newsletters from public bodies, scientific journals and agronomists were highly correlated with the first factor. After analyzing the median scores of the respondents' responses to the variables loading on factor 1, it is clear that 'agronomist' (median: 4; IQR: 2) is the most common specialized source of information on pesticides. Variables loading on the second factor include participants' perceptions of the contribution of pesticides to national income and to increased food production, and statements that the correct use of pesticides provides safety to the user or consumer. This is therefore related to "Perceived contributions of pesticides" and accounts for 10.9% of the variance. The sense of security from traceability and the confidence in the safety of certified and IPM foods loaded on the third factor, "Confidence in food certification procedures", which accounts for 10.3% of the variance. Variables loading on the fourth factor, "General sources of information about pesticides", explaining 9.2% of the variance, included the printed and electronic press, as well as television and radio, as sources of information about pesticides. The fifth factor consisted of variables representing "Perceived threats of pesticides", which accounted for 8.4% of the total variance. Participants' attitudes about their health status in relation to pesticides, their concerns about pesticide residues in food, and their sense of insecurity about the health of their own people all loaded on factor 5.

Logistic regression model

A binary logistic regression analysis was conducted to identify predictors of perceived ICM food safety. Specifically, the dependent variable is the participant's response to the statement "Food produced by integrated crop management is safe in terms of pesticide residues". Stepwise analysis revealed that "gender" and "age", as well as three of five factors previously retained from FA, contributed significantly to the model.

The performance measures of the model, sensitivity (% of cases that had the outcome correctly predicted) and specificity (% of cases correctly predicted as not having the outcome) are 93.2% and 70.1%, respectively. The overall predictive accuracy of the model as measured by the AUC value (area under the ROC curve) is 0.918, which is considered very good for the model fit (Table 3).

Positive and statistically significant regression coefficients were found for "Confidence in plant food certification procedures" ($b = 2.401$; $p < 0.001$), "Specialized information sources" ($b = 0.454$; $p < 0.001$), "Perceived pesticides' contributions" ($b = 0.318$; $p < 0.001$), "Male gender" ($b = 0.586$; $p < 0.001$) and "age" (older than 45 years old, $b = 0.561$; $p < 0.001$).

TABLE 2. Factor analysis

Original variables (5-point Likert scale statements)	Median [(1)]	IQR [(2)]	Factors					Uniqueness [(3)]
			Specialized information sources	Perceived pesticides' contributions	Confidence in food certification procedures	General information sources	Perceived pesticides' threats	
I get informed about pesticides by Official Websites	3	2	0.935					0.185
…by Public Bodies Newsletters	3	2	0.823					0.339
…by Scientific Journals	3	2	0.792					0.367
…by an Agronomist	4	3	0.596					0.567
Pesticides contribute to the increase in national income	4	1		0.775				0.493
Pesticides contribute to increased food production	4	1		0.697				0.578
Their proper application secures the user	4	2		0.650				0.503
Their proper application secures the consumer	4	2		0.582				0.516
The existence of labelling (traceability) reassures me	4	1			0.799			0.383
Certified products are safe	4	1			0.758			0.461
Integrated farming management products are safe	4	1			0.710			0.443

I get informed about pesticides by Press	2	2				0.747		0.386
…by Electronic Press	3	2				0.704		0.424
…by Television-Radio	2	2				0.670		0.551
I think my health has been affected	3	1					0.786	0.327
I'm worried about my safety from pesticides residues in food	5	1					0.689	0.547
I feel insecure about the health of my own people	4	2					0.560	0.694
Sum of the squared loadings			2.631	1.858	1.750	1.571	1.425	
Scale reliability (McDonald's ω)			0.862	0.773	0.795	0.761	0.715	
Explained variance %			0.155	0.109	0.103	0.092	0.084	
Cumulative variance %			0.155	0.264	0.367	0.459	0.543	
Bartlett's Test of Sphericity	$X^2 = 11139$; df = 136; $p < 0.001$							
KMO Measure of Sampling Adequacy test	0.793							

(1): Median values of the distribution of participants's replies to the 5-point Likert scale questions (1 = never to 5 = habitually, or 1 = totally disagree to 5 = totally agree, whatever applicable).
(2): Interquartile range
(3): Proportion of variance that is "unique" to the variable and not explained by the factors. Uniqueness is equal to 1 – Communality. The lower the Uniqueness the greater the relevance of the variable in the model.
Note: oblique "promax" rotation was used, variable loadings > 0.5 and Uniqueness < 0.7 were selected.

Table 3. Results of binomial logistic regression analysis

Predictor	Estimate b	95% Confidence Interval		Wald test			Odds ratio	95% Confidence Interval	
		Lower	Upper	Wald statistic	df	p		Lower	Upper
Intercept	0.786	0.541	1.031	39.443	1	< 0.01	2.195	1.717	2.805
"*Confidence in plant food certification procedures*"	2.401	2.162	2.640	388.565	1	< 0.01	11.034	8.691	14.010
"*Specialized information sources*"	0.454	0.299	0.609	32.874	1	< 0.01	1.574	1.348	1.838
"*Perceived pesticides' contributions*"	0.318	0.165	0.470	16.676	1	< 0.01	1.374	1.180	1.600
Male gender	0.586	0.291	0.882	15.127	1	< 0.01	1.797	1.338	2.415
Age (older than 45 years old)	0.561	0.275	0.846	14.781	1	< 0.01	1.752	1.316	2.331
Predictive measures: AUC = 0.918; Sensitivity = 0.932; Specificity = 0.701									
Note: Estimates represent the log odds of "ICM plant-based food is safe = 1" vs. "ICM plant-based food is safe = 0"									

This suggests that those who were more likely to be willing to accept the safety of ICM foods were those who were more confident in the certification of plant foods, who received the most information on pesticides from specialist sources, who reported a higher perception of the impact of pesticides, who were male and over 45 years of age.

According to the odds ratios, the likelihood of a participant assuming that ICM plant foods are safe varies by a factor of 11.03 (95% CI: 8.69 - 14.01) for each unit increase in their propensity towards "Confidence in plant food certification procedures", 1.57 (95% CI: 1.35 - 1.84) for each unit increment in their frequency of getting information about pesticides from "Specialized information sources", 1.37 (95% CI: 1.18 - 1.60) per unit increase towards "Perceived contributions of pesticides", 1.80 (95% CI: 1.34 - 2.42) if they are "Male" and 1.75 (95% CI: 1.32 - 2.33) if they are over 45 years of age.

Discussion

This study examined the attitudes and perceptions of Greek consumers regarding the safety of plant-based commodities produced through integrated crop management principles in terms of pesticide residues. To the best of our knowledge, this is the first large-scale survey of Greek consumers' attitudes on this issue. Respondents to this survey derive from all regions of Greece, live in both urban and rural areas and are equally divided between men and women. All age groups, from 18 to over 65, were adequately represented.

Data analysis, using the median value of the distribution of participants replies as central tendency measure, revealed partial agreement to the statement under consideration, i.e. whether or not participants perceive positively the safety of ICM plant-foods. A significantly higher proportion of favorable responses was evident. A 69% of the respondents to the survey of the present study seem to be supportive of a statement implying the safety of ICM produced plant-foods regarding pesticides residues. Taking into account the results of the recent special Eurobarometer survey on food safety in the EU, this result seems to be expected. Greek consumers ranked pesticide residues as the most important food safety concern, followed by food additives and residues of antibiotics, hormones or steroids in meat (European Food Safety Authority, 2022).

The basic hypothesis that consumers' perceptions and personal views on a range of statements, in addition to socio-demographic characteristics, serve to describe how they feel about the safety of ICM food products was confirmed by the overall regression model. According to the results, there is evidence that participants supported the statement that ICM food products are safe in terms of pesticide residues if they were confident in the crop-food certification process, if they were most likely to be informed about pesticides by specialized information sources, and if they supported the positive contributions of pesticide use. Similarly positive responses were recorded if the participants were male and in an older age group.

The stronger consumer's attitude with positive predictive influence on consumer's perceptions on ICM plant-foods is the confidence in plant food certification procedures. This trust stems from the importance of the concept of traceability, which is a crucial element for consumers when it comes to the information provided by plant food labelling, and the sense of assurance fostered by the certification process. Participants agreed to the above variables. The results confirm previous findings on the importance of certification, information provision and labelling for the ability of Greek consumers to assess the quality of the food they purchase

(Karagianni et al., 2003; Dimara and Skuras, 2005; Krystallis and Chryssohoidis, 2005; Krystallis et al., 2006; Tsakiridou et al., 2006; 2008; 2009; 2011; 2012). According to Ueland et al. (2012), reputable organizations can compensate for the lack of consumer control.

Information plays an essential role in consumer perceptions of pesticide use and food safety, as our results show. A significant predictor of participants' favorable attitudes towards the safety of ICM-produced plant foods is their information on pesticides from specialized sources. Agronomists seem to be the most common source of information on pesticides among specialized sources. This is explained by the fact that in Greece, legislation on pesticides stipulates that certain scientific requirements must be fulfilled before a natural or legal person can be actively involved in the pesticide trade (Vlachos, 2016). However, official websites, newsletters of public institutions and scientific journals were significantly more strongly associated with the factor of specialized information sources.

Perceived contributions of pesticides appear to be an additional predictor of consumer attitudes towards the research question. They can be subdivided into the constituent variables of the contribution of pesticides to the national income, their necessity to ensure crop production and food security, and the belief that the user and the consumer can be protected by the correct use of pesticides. In terms of central tendency, respondents agreed with each of the previous statements. Perceived pesticide contributions seem to influence the judgments of participants in favor of the statement that the ICM food-products are safe in terms of pesticide residues. A recent study showed that consumers' perceptions of the contribution of pesticides were the strongest predictor of their risk-benefit assessments regarding pesticides use (Simoglou and Roditakis, 2022). Our results are consistent with Dunlap and Beus (1992) who reported that perceptions of the necessity of pesticide use were the most important predictor of public attitudes towards pesticides.

Male gender has a significant impact on consumer perspectives, which has a positive effect on the acceptability of pesticide safety in ICM crop products. This is consistent with previous research showing that males have a higher acceptance of the benefits of pesticide use relative to their potential negative effects (Simoglou and Roditakis, 2022), while females have a higher risk perception of chemical residues than males (Dunlap and Beus, 1992; Huang, 1993; Karagianni et al., 2003; Dickson-Spillmann et al., 2011; Koch et al., 2017).

Several limitations should be taken into account concerning our study. Firstly, our results were obtained through web survey disseminated by email, Messenger and Viber applications, hence anyone unfamiliar with communication technology was inevitably excluded. These individuals might have a low educational level or belong to older age groups. Secondly, the data were collected from self reporting opinions with no means of checking their veracity. Thirdly, the sample was collected from all over Greece, however, it may not be representative of the Greek population in several aspects (i.e. education, occupation, age group >65 years etc.). Fourthly, although information sources were investigated, the study did not address other possible sources of information on pesticides like friends and family, peers, other internet content, bloggers, influencers, participation in collectives, consumer associations, activist organizations, etc., which constitute a proposal that future studies should further explore these issues.

Conclusions

This study represents a first attempt to identify the primary predictors influencing the perceived safety of ICM foods among Greek consumers. It was found that Greek consumers have a strong perception of the safety of ICM foods. Data analysis revealed a number of significant predictors of consumer attitudes related to personal beliefs about pesticide use, age, gender, trust in certification procedures and information received. Our findings have a number of implications for food safety risk literacy training programs to improve the public's understanding of the information they receive and to reassure consumers about the safety of the plant food supply chain from farm to fork. There is a need for risk communication efforts that address food safety issues to the general public through information sources that are designed for a broad audience. In order to avoid undue fear and anxiety among the general public, it is considered necessary to foster a stronger relationship between journalists and scientists, as well as to increase the involvement of government agencies. It is also considered essential to make the work of food safety authorities more visible to the general public.

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References

Alhakami, A. S., and P. Slovic. 1994. A Psychological Study of the Inverse Relationship Be-tween Perceived Risk and Perceived Benefit. Risk Analysis. 14: 1085–1096 https://doi.org/10.1111/j.1539- 6924.1994.tb00080.x

Atreya, N. 2000. Pesticides in Perspective Does the mere presence of a pesticide residue in food indicate a risk? J. Environ. Monitor 2: 53N-56N https://doi.org/10.1039/b003623o

Anastasiadis, F., I. Manikas, I. Apostolidou, and S. Wahbeh. 2022. The role of traceability in end-to-end circular agri-food supply chains. Industrial Marketing Management. 104: 196–211. https://doi.org/10.1016/j.indmarman.2022.04.021

Beckman, J., M. Ivanic, and J. Jelliffe. 2022. Market impacts of Farm to Fork: Reducing agri-cultural input usage. Applied Eco Perspectives Pol. 44: 1995–2013. https://doi.org/10.1002/aepp.13176

Bolognesi, C., and G. Morasso. 2000. Genotoxicity of pesticides. Trends in Food Science and Technology. 11: 182–187. https://doi.org/10.1016/S0924-2244(00)00060-1

Botonaki, A., K. Polymeros, E. Tsakiridou, and K. Mattas. 2006. The role of food quality certification on consumers' food choices. British Food Journal. 108: 77–90 https://doi.org/10.1108/00070700610644906

Bourguet, D., and T. Guillemaud. 2016. The Hidden and External Costs of Pesticide Use, pp. 35–120. In Lichtfouse, E. (ed.), Sustainable Agriculture Reviews. Springer International Publishing, Cham. https://doi.org/10.1007/978-3-319-26777-7_2

Cooper, J., and H. Dobson. 2007. The benefits of pesticides to mankind and the environment. Crop Protection. 26: 1337-1348 https://doi.org/10.1016/j.cropro.2007.03.022

Coppin, D. M., B. W. Eisenhauer, and R. S. Krannich. 2002. Is Pesticide Use Socially Ac-ceptable? A Comparison between Urban and Rural Settings. Social Science Q. 83: 379–394. https://doi.org/10.1111/1540-6237.00090

Damalas, C. A., and I. G. Eleftherohorinos. 2011. Pesticide Exposure, Safety Issues, and Risk Assessment Indicators. IJERPH. 8: 1402–1419. https://doi.org/10.3390/ijerph8051402

De Bon, H., J. Huat, L. Parrot, A. Sinzogan, T. Martin, E. Malézieux, and J.-F. Vayssières. 2014. Pesticide risks from fruit and vegetable pest management by small farmers in sub-Saharan Africa. A review. Agron. Sustain. Dev. 34: 723–736. https://doi.org/10.1007/s13593-014-0216-7

Dickson-Spillmann, M., M. Siegrist, and C. Keller. 2011. Attitudes toward chemicals are asso-ciated with preference for natural food. Food Quality and Preference. 22: 149–156. https://doi.org/10.1016/j.foodqual.2010.09.001

Dimara, E., and D. Skuras. 2005. Consumer demand for informative labeling of quality food and drink products: a European Union case study. Journal of Consumer Marketing. 22: 90–100. https://doi.org/10.1108/07363760510589253

Dunlap, R. E., and C. E. Beus. 1992. Understanding Public Concerns About Pesticides: An Empirical Examination. Journal of Consumer Affairs. 26: 418–438. https://doi.org/10.1111/j.1745-6606.1992.tb00035.x

European Commission. 2023. Farm to Fork strategy for a fair, healthy and environmentally-friendly food system. Retrieved from https://ec.europa.eu/food/horizontal-topics/farm-fork-strategy_en. Accessed on 17 June 2023.

EFSA (European Food Safety Authority). 2023. Food safety in the EU. Publications Office, LU. Retrieved from https://www.efsa.europa.eu/en/corporate/pub/eurobarometer22. Ac-cessed on 17 June 2023.

EFSA (European Food Safety Authority), P. S. Craig, B. Dujardin, A. Hart, A. F. Hernández-Jerez, S. Hougaard Bennekou, C. Kneuer, B. Ossendorp, R. Pedersen, G. Wolterink, and L. Mohimont. 2020. Cumulative dietary risk characterisation of pesticides that have acute effects on the nervous system. EFS2. 18. https://doi.org/10.2903/j.efsa.2020.6087

EFSA (European Food Safety Authority), P. S. Craig, B. Dujardin, A. Hart, A. F. Hernandez-Jerez, S. Hougaard Bennekou, C. Kneuer, B. Ossendorp, R. Pedersen, G. Wolterink, and L. Mohimont. 2020. Cumulative dietary risk characterisation of pesticides that have chron-ic effects on the thyroid. EFS2. 18. https://doi.org/10.2903/j.efsa.2020.6088

EFSA (European Food Safety Authority), 2021. Statement on the comparison of cumulative dietary exposure to pesticide residues for the reference periods 2014–2016 and 2016–2018. EFS2 19. https://doi.org/10.2903/j.efsa.2021.6394

FAO. 1998. The Application of Risk Communication to Food Standards and Safety Matters. Rome, FAO. Retrieved from http://www.fao.org/3/x1271e/x1271e.pdf. Accessed on 08 Oct. 2021.

FAO. 2020. FAO Guide to Ranking Food Safety Risks at the National Level. Rome, FAO. Retrieved from https://doi.org/10.4060/cb0887en. Accessed on 08 Oct. 2021.

Gustavsson, J., Cederberg, J. and Sonesson, U. 2011. Global food losses and food waste: Ex-tent, causes and prevention; Food and Agriculture Organization of the United Nations. Re-trieved from https://www.fao.org/sustainable-food-value-chains/library/details/en/c/266053/. Accessed on 08 Oct. 2021.

Hair, J.F. 2019. Multivariate data analysis (8th ed). Cengage, Andover, Hampshire.

Harris, C. A., M. J. Renfrew, and M. W. Woolridge. 2001. Assessing the risks of pesticide resi-dues to consumers: recent and future developments. Food Additives and Contaminants. 18: 1124–1129. https://doi.org/10.1080/02652030110050122

Hayes, A. F., and J. J. Coutts. 2020. Use Omega Rather than Cronbach's Alpha for Estimating Reliability. But…. Communication Methods and Measures. 14: 1–24. https://doi.org/10.1080/19312458.2020.1718629

Hohl, K., and G. Gaskell. 2008. European Public Perceptions of Food Risk: Cross-National and Methodological Comparisons: European Public Perceptions of Food Risk. Risk Anal-ysis. 28: 311–324. https://doi.org/10.1111/j.1539-6924.2008.01021.x

Huang, C. L. 1993. Simultaneous-Equation Model for Estimating Consumer Risk Perceptions, Attitudes, and Willingness-to-Pay for Residue-Free Produce. Journal of Consumer Affairs. 27: 377–396. https://doi.org/10.1111/j.1745-6606.1993.tb00754.x

JASP Team (2023). JASP (Version 0.17.2) [Computer software]. https://jasp-stats.org

Karagianni, P., E. Tsakiridou, H. Tsakiridou, and K. Mattas. 2003. Consumer perceptions about fruit and vegetable quality attributes: evidence from a Greek survey. Acta Hortic. 345–352. https://doi.org/10.17660/ActaHortic.2003.604.36

Koch, S., A. Epp, M. Lohmann, and G.-F. Böl. 2017. Pesticide Residues in Food: Attitudes, Beliefs, and Misconceptions among Conventional and Organic Consumers. Journal of Food Protection. 80: 2083–2089. https://doi.org/10.4315/0362-028X.JFP-17-104

Kortenkamp, A. 2007. Ten Years of Mixing Cocktails: A Review of Combination Effects of Endocrine-Disrupting Chemicals. Environ Health Perspect. 115: 98–105. https://doi.org/10.1289/ehp.9357

Krystallis, A., and G. Chryssohoidis. 2005. Consumers' willingness to pay for organic food: Factors that affect it and variation per organic product type. British Food Journal. 107: 320–343. https://doi.org/10.1108/00070700510596901

Krystallis, A., C. Fotopoulos, and Y. Zotos. 2006. Organic Consumers' Profile and Their Will-ingness to Pay (WTP) for Selected Organic Food Products in Greece. Journal of Interna-tional Consumer Marketing. 19: 81–106. https://doi.org/10.1300/J046v19n01_05

Krystallis, A., L. Frewer, G. Rowe, J. Houghton, O. Kehagia, and T. Perrea. 2007. A percep-tual divide? Consumer and expert attitudes to food risk management in Europe. Health, Risk and Society. 9: 407–424. https://doi.org/10.1080/13698570701612683

Magkos, F., F. Arvaniti, and A. Zampelas. 2006. Organic Food: Buying More Safety or Just Peace of Mind? A Critical Review of the Literature. Critical Reviews in Food Science and Nutrition. 46: 23–56. https://doi.org/10.1080/10408690490911846

Navarro, D. J., and D. R. Foxcroft. 2018. Learning statistics with jamovi: a tutorial for psy-chology students and other beginners. Danielle J. Navarro and David R. Foxcroft. https://doi.org/10.24384/HGC3-7P15

Nicolopoulou-Stamati, P., S. Maipas, C. Kotampasi, P. Stamatis, and L. Hens. 2016. Chemical Pesticides and Human Health: The Urgent Need for a New Concept in Agriculture. Front. Public Health. 4 https://doi.org/10.3389/fpubh.2016.00148

Peeters, A., O. Lefebvre, and L. Balogh. 2021. A Green Deal for implementing agroecological systems: Reforming the Common Agricultural Policy of the European Union. Land-bauforschung : journal of sustainable and organic agricultural systems. 83–93. https://doi.org/10.3220/LBF1610123299000

Savary, S., A. Ficke, J.-N. Aubertot, and C. Hollier. 2012. Crop losses due to diseases and their implications for global food production losses and food security. Food Sec. 4: 519–537. https://doi.org/10.1007/s12571-012-0200-5

Savary, S., L. Willocquet, S. J. Pethybridge, P. Esker, N. McRoberts, and A. Nelson. 2019. The global burden of pathogens and pests on major food crops. Nat Ecol Evol. 3: 430–439. https://doi.org/10.1038/s41559-018-0793-y

Schebesta, H., and J. J. L. Candel. 2020. Game-changing potential of the EU's Farm to Fork Strategy. Nat Food. 1: 586–588. https://doi.org/10.1038/s43016-020-00166-9

Sharma, S., R. Kooner, and R. Arora. 2017. Insect Pests and Crop Losses, pp. 45–66. In Aro-ra, R., Sandhu, S. (eds.), Breeding Insect Resistant Crops for Sustainable Agriculture. Springer Singapore, Singapore. https://doi.org/10.1007/978-981-10-6056-4_2

Simoglou, K. B., and E. Roditakis. 2022. Consumers' Benefit—Risk Perception on Pesticides and Food Safety—A Survey in Greece. Agriculture. 12: 192. https://doi.org/10.3390/agriculture12020192

Tago, D., H. Andersson, and N. Treich. 2014. Pesticides and Health: A Review of Evidence on Health Effects, Valuation of Risks, and Benefit-Cost Analysis, pp. 203–295. In Blomquist, G.C., Bolin, K. (eds.), Advances in Health Economics and Health Services Research. Em-erald Group Publishing Limited. https://doi.org/10.1108/S0731-219920140000024006

Tsakiridou, E., C. Boutsouki, Y. Zotos, and K. Mattas. 2008. Attitudes and behaviour towards organic products: an exploratory study. International Journal of Retail and Distribution Management. 36: 158–175. https://doi.org/10.1108/09590550810853093

Tsakiridou, E., K. Mattas, and P. Bazoche. 2012. Consumers' response on the labels of fresh fruits and related implications on pesticide use. Food Economics. 9: 129–134. https://doi.org/10.1080/16507541.2012.695113

Tsakiridou, E., K. Mattas, and Z. Mpletsa. 2009. Consumers' Food Choices for Specific Quali-ty Food Products. Journal of Food Products Marketing. 15: 200–212. https://doi.org/10.1080/10454440902908217

Tsakiridou, E., K. Mattas, H. Tsakiridou, and E. Tsiamparli. 2011. Purchasing Fresh Produce on the Basis of Food Safety, Origin, and Traceability Labels. Journal of Food Products Marketing. 17: 211–226. https://doi.org/10.1080/10454446.2011.548749

Tsakiridou, E., Y. Zotos, and K. Mattas. 2006. Employing a Dichotomous Choice Model to Assess Willingness to Pay (WTP) for Organically Produced Products. Journal of Food Products Marketing. 12: 59–69. https://doi.org/10.1300/J038v12n03_05

Ueland, Ø., H. Gunnlaugsdottir, F. Holm, N. Kalogeras, O. Leino, J. M. Luteijn, S. H. Mag-núsown, G. Odekerken, M. V. Pohjola, M. J. Tijhuis, J. T. Tuomisto, B. C. White, and H. Verhagen. 2012. State of the art in benefit–risk analysis: Consumer perception. Food and Chemical Toxicology. 50: 67–76. https://doi.org/10.1016/j.fct.2011.06.006

Vlachos, D. 2016. Rational use of pesticides. Prescription. Challenges and prospects. In Pro-ceedings of the 18th Panhellenic Phytopathological Congress, Heraklion, Greece, 18–21 October 2016. http://entsoc.gr/site/index.php/praktika/file/118-18pesgr

Whaley, S. R., and M. Tucker. 2004. The Influence of Perceived Food Risk and Source Trust on Media System Dependency. Journal of Applied Communications. 88. https://doi.org/10.4148/1051-0834.1315

Wilcock, A., M. Pun, J. Khanona, and M. Aung. 2004. Consumer attitudes, knowledge and behaviour: a review of food safety issues. Trends in Food Science and Technology. 15: 56–66. https://doi.org/10.1016/j.tifs.2003.08.004

Γεωργικά φάρμακα και προϊόντα ολοκληρωμένης διαχείρισης Παράγοντες που επηρεάζουν την αποδοχή τους από τους καταναλωτές

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ΠΕΡΙΛΗΨΗ

Οι επικείμενες αλλαγές στην Κοινή Αγροτική Πολιτική της ΕΕ αναμένεται να επιφέρουν αλλαγές στα γεωργικά τρόφιμα, όσον αφορά τη χρήση γεωργικών φαρμάκων και την πιστοποίηση τροφίμων. Η γνώση των παραγόντων που επηρεάζουν τις αντιλήψεις των καταναλωτών για τα πιστοποιημένα τρόφιμα ολοκληρωμένης διαχείρισης καλλιεργειών (ICM) είναι ουσιώδης για την πραγματοποίηση μελλοντικών στοχευμένων παρεμβάσεων ή τη λήψη διορθωτικών μέτρων. Για το σκοπό αυτόν, την άνοιξη του 2021, διεξήχθη έρευνα στην Ελλάδα με 1.846 συμμετέχοντες. Εφαρμόστηκε διερευνητική παραγοντική ανάλυση στις μεταβλητές του ερωτηματολογίου και ακολούθησε ανάλυση διωνυμικής λογαριθμικής παλινδρόμησης όσον αφορά το ερευνητικό ερώτημα: Εάν οι συμμετέχοντες στην έρευνα θεωρούν τα τρόφιμα ICM ασφαλή ή όχι, όσον αφορά την παρουσία υπολειμμάτων γεωργικών φαρμάκων. Μεταξύ των συμμετεχόντων, η πιθανότητα να εκφράσουν θετική στάση ως προς το ερευνητικό ερώτημα ήταν μεγαλύτερη μεταξύ εκείνων που εμπιστεύονται την πιστοποίηση τροφίμων, εκείνων που ενημερώνονται για τα γεωργικά φάρμακα από εξειδικευμένες πηγές πληροφόρησης, στους άνδρες, σε όσους που αντιλαμβάνονται θετικά τη συμβολή των γεωργικών φαρμάκων και τέλος, στους μεγαλύτερους σε ηλικία (> 45 ετών). Τα αποτελέσματα δείχνουν ότι οι καταναλωτές θεωρούν ότι τα τρόφιμα ICM είναι ασφαλή και αποδεκτά όσον αφορά τα θέματα χρήσης γεωργικών φαρμάκων.

