Discussion on Response Mechanism of Genetically Modified Food Safety Incidents Based on OLS and PSM Methods

Zixuan Cai(✉)

Beijing Keystone Academy, Beijing 101318, China
priscillacaihaohao@163.com

Abstract. The issue of GM food safety not only involves the daily dietary needs of people, but also affects the national food security and the development ability of the national economic level. The lack of corresponding measures to deal with GM food safety incidents in China will lead to the existing contradictory problems being continuously magnified and eventually affect people's dietary safety. In order to solve the above problems, this paper discusses the response mechanism of GM food safety events based on OLS and PSM methods, starting from the emergency characteristics of GM food safety events, this paper analyzes whether substandard food will pose a threat to people's daily diet, evaluating the application capability of the developed handling measures by combining OLS and PSM methods, integrating various influencing factors, and establishing a perfect response mechanism of GM food safety events.

Keywords: OLS Method · PSM Method · Genetically Modified Foods · Safety Incidents · Coping Mechanism

1 Introduction

Genetically modified foods are foods produced by using modern molecular biotechnology, in which the gene sequences of certain specific organisms are artificially transferred to other species during processing, creating new organisms while modifying their genetic characteristics so that they can be transformed according to the desired goals in terms of nutritional value, performance traits, etc. GM food safety is a new definition derived from the traditional food safety concept. The so-called food safety means that the food itself must meet the nutritional requirements of non-toxic and harmless, and with the increase of consumption, these foods must not cause any harm to human health [1]. In recent years, with the development of academic research fields such as food science and nutrition, food safety has also attracted wide attention from all walks of life. Especially in the process of food processing and processing, how to fully stimulate its health value on the basis of ensuring its nutritional components has become an urgent problem to be solved. GM food safety puts forward higher requirements on the basis of existing food safety problems. On the one hand, it strictly standardizes the operation process of GM treatment, requiring that all treatment means should not damage the nutritional value of

R. B. B. M. Hussain et al. (Eds.): ICHSSR 2023, ASSEHR 765, pp. 1493–1500, 2023.
https://doi.org/10.2991/978-2-38476-092-3_191

food itself. On the other hand, it also requires relevant production units to remove toxic trace elements that may pose a threat to human safety through certain methods in the process of GM treatment.

In previous studies, Yani Li, Xiaoyun He, and Wentao Xu argued that the evaluation of GM food safety can be done with the help of interfering RNA technology, and by analyzing the digestion and metabolism of different types of GM foods in humans, it is possible to grasp whether such foods have undergone uncontrollable shape mutations during the transgenic treatment [2]. Generally speaking, in the field of food safety research, most researchers agree with the view that "the slower the food metabolism is, the more nutrients are accumulated", and the conventional transgenic treatment methods will not affect the nutritional characteristics of the food itself. However, with the continuous development of transgenic technology, some specific toxic trace elements can not be completely removed. The long-term use of this transgenic food will not only cause the decline of human immunity, but also may affect some specific human functions. In order to solve the above problems, so that GM food can not only meet people's daily dietary needs, but also promote the national food security and national economic development, OLS and PSM research methods are introduced, and on this basis, the specific implementation methods of the GM food safety incident response mechanism are discussed.

2 Emergency Characteristics of Genetically Modified Food Safety Incidents

When discussing the GM food safety response mechanism, we should comprehensively consider three aspects: allergic reaction, biological gene pollution, destruction of ecological environment and biodiversity.

In the process of processing genetically modified food, gene recombination may fully express proteins that are easy to cause human allergy, so the risk and probability of human allergic reaction will increase. When the degree of allergic reaction is severe enough, it may even threaten human life. For some foods that have the ability to sensitize themselves, after being genetically modified in the current period, the human body's ability to absorb allergen proteins is greatly enhanced. At this time, under the specific catalysis, allergic reactions will be treated. Considering only allergic safety events, the expression for solving the emergency characteristics of genetically modified food can be defined as:

$$e_1 = i \cdot \frac{\sqrt{R \times p}}{|\Delta T|} \tag{1}$$

In the above formula, ΔT represents the performance time of allergic reaction, R represents the transgenic recombination coefficient of allergen protein, p represents the sensitization ability index of transgenic food, and i represents the performance coefficient of allergic reaction.

As for genetically modified food, the role of biological gene pollution includes gene recombination, new gene sequence generation, food cultivation, food transportation,

food sales, human consumption and other processes. Generally speaking, when recombination occurs, dangerous genes have been largely copied, and the copied transgenic protein will fuse with the original protein, thus greatly enhancing the biological pollution ability of transgenic food [3]. In order for the food safety incident response mechanism to effectively solve the problem of biological gene pollution caused by genetically modified food, the gene sequence of the processed food should be measured for many times, and the gene fragments with polluting ability should be removed through manual treatment. However, the nutritional value of genetically modified food should not be damaged during the whole operation process. The expression for solving the emergency characteristics of genetically modified food can be defined as:

$$e_2 = \sum_{\alpha=1}^{+\infty} |w_\delta - w_0| / q \cdot \hat{u} \tag{2}$$

where α represents the replication coefficient of transgenic protein, w_0 represents the initial cumulative value of contaminated transgenic protein, w_δ represents the cumulative value of contaminated transgenic protein at time δ, $\hat{u}$ represents the intensity of biological gene contamination, and q represents the number of transgenic actions of contaminated protein.

Since GM foods have a greater ability to adapt, their impact in terms of ecological damage and biodiversity is mainly manifested by inhibiting the growth and survival of non-GM organisms. In the long term, it will be difficult for non-GMOs to reproduce, which will not only make the natural ecosystem biologically homogeneous, but will also cause the human body to consume a single food and eventually lead to a reduction in the total intake of nutritional substances, which is contrary to the original purpose of the development of the safety of genetically modified foods [4]. Considering solely safety events that damage the ecosystem and biodiversity, the emergency characterization expression for GM foods can be defined as:

$$e_3 = \frac{\phi \times (o_{\max} - o_{\min})^2}{(1-\gamma) \cdot f} \tag{3}$$

where ϕ denotes the ecological adaptation coefficient of the GM food, $o_{\min}$ denotes the minimum assignment of biodiversity characteristics, $o_{\max}$ denotes the maximum assignment of biodiversity characteristics, γ denotes the ecological damage coefficient of the GM food, and f denotes the biodiversity characteristics of the GM food.

3 Description of Coping Strategies Based on OLS and PSM Methods

3.1 OLS Method

The OLS method is the most basic data treatment in regressivity analysis. In its application, the method requires very few model conditions, and the sum of squares of the samples to be measured can be controlled at a relatively low value level even if only the value of the distance between individual observations and the regression line is known.

Table 1. Definition of genetically modified food safety Incidents

No.	Common Genetically Modified Food Safety Incidents	Defining formula
1	Personnel allergies	e_1
2	Biological genetic contamination	e_2
3	Damage to the ecosystem and biodiversity	e_3
4	Protein transgenic failure	e_4
5	Genetically modified foods are too toxic	e_5

In the process of establishing a response mechanism for GM food safety incidents, if the OLS method is used as a constraint, it is possible to avoid large-scale sampling of the data to be measured and to master an effective approach for GM food safety events by relying only on the numerical presentation of a single few indicator covariates [5]. Several common manifestations of GM food safety events are recorded below:

Using the common GM food safety incidents de、finition covariates in Table 1, the conditions of action for food safety event response based on the OLS approach can be expressed as

$$A_1 = \frac{\varpi_1 e_1 + \varpi_2 e_2 + \varpi_3 e_3 + \varpi_4 e_4 + \varpi_5 e_5}{|\Delta S|} \tag{4}$$

In the above equation, ϖ_1, ϖ_2, ϖ_3, ϖ_4 and ϖ_5 denote the safety definition covariates matched with events e_1, e_2, e_3, e_4 and e_5, respectively, and the inequality conditions of $\varpi_1 \neq 0$, $\varpi_2 \neq 0$, $\varpi_3 \neq 0$, $\varpi_4 \neq 0$ and $\varpi_5 \neq 0$ hold simultaneously, and ΔS denotes GM food intake.

The values of e_1, e_2, e_3, e_4 and e_5 were specified to be exactly equal, and the ability of the OLS method to influence the response mechanism of GM food safety events could be judged based on the changes in the values of ϖ_1, ϖ_2, ϖ_3, ϖ_4 and ϖ_5 indicators. The specific values are shown in Table 2.

Analysis of Table 2 shows that with the increasing values of e_1, e_2, e_3, e_4 and e_5, the A1-indicators also show increasing values, and the -indicators do not change in this

Table 2. Judgment of response mechanism of GM food safety incidents based on OLS method

number of times	ϖ_1	ϖ_2	ϖ_3	ϖ_4	ϖ_5	e_1	e_2	e_3	e_4	e_5	ΔS	A_1
1	20%	20%	20%	20%	20%	0.45	0.23	0.51	0.36	0.62	1	1.65
2	20%	20%	20%	20%	20%	0.47	0.28	0.54	0.41	0.65	1	1.79
3	20%	20%	20%	20%	20%	0.51	0.36	0.58	0.44	0.69	1	1.82
4	20%	20%	20%	20%	20%	0.52	0.39	0.60	0.47	0.71	1	1.88
5	20%	20%	20%	20%	20%	0.56	0.42	0.63	0.49	0.73	1	1.93

process, which means that the intake of GM food does not have a direct impact on the performance ability of food safety events.

In summary, it can be concluded that under the influence of the OLS approach, if the manifestation of a GM food safety incident remains the same, the severity level presented by the incident will all change as the safety level of the incident continues to change. Therefore, under the OLS method, in order to improve the response mechanism for GM food safety incidents, screening can be conducted for the intensity of the incident manifestation, and efforts can be stepped up to manage unreasonable GM foods while ensuring that human safety is not disturbed, thus making the timely handling capability of the designated response mechanism guaranteed.

3.2 PSM Method

PSM method can process the basic information of things according to the set execution process, which can not only realize the effective control of the occurring incidents, but also improve the chance of successful execution of possible incidents, so as to avoid unnecessary losses and achieve the purpose of effective prevention. Compared with OLS method, the impact of PSM method on the response mechanism of GM food safety incidents is mainly reflected in the process [6]. In the process of practical application, PSM method can distinguish a variety of different GM food safety incidents, and judge whether the current response mechanism can effectively deal with the incident through the performance intensity of the incident. Generally speaking, when the performance of GM food safety incidents is bad, the role value of PSM method will be significantly higher than that of OLS method.

4 Basic Response Mechanism for GM Food Safety Incidents

4.1 Application Framework

Under the role of OLS and PSM methods, the basic response mechanism for GM food safety events should be established by improving the application framework according to Fig. 1. Firstly, we analyze the ability of relevant safety indicators to influence GM food safety events according to the OLS method, and select the key discriminative parameters from them; secondly, we refine the implementation ability of the developed response mechanism according to the PSM method application principle; then we list various manifestations of GM food safety events, and match them with the OLS method application principle and PSM method application principle respectively. Then, we will match them with the application principles of the OLS method and the PSM method, and determine whether the current response strategies can meet the demands of fully responding to GM food safety events based on the established solution relationships.

4.2 Well Composed Structure

In terms of composition and structure, the improvement of the basic response mechanism to GM food safety incidents should select appropriate evaluation models to meet people's

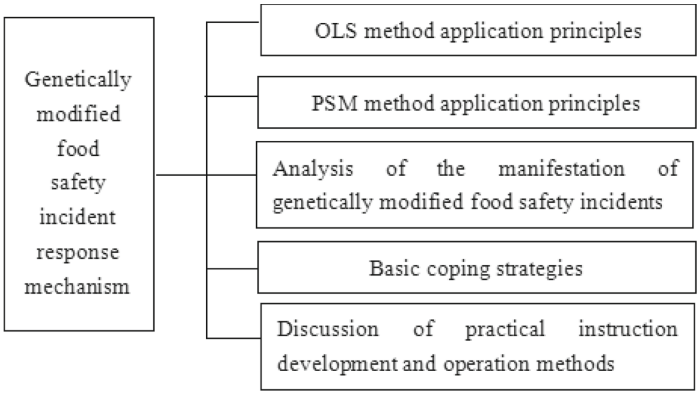

Fig. 1. A framework for applying basic response mechanisms to genetically modified food safety incidents

daily dietary needs on the one hand, and fundamentally ensure the national food security on the other hand, so as to make the national economy develop rapidly. The OLS method and the PSM method, as two common laws of action, are practiced with the aim of improving the presentation of GM food safety problems, giving a concrete description of the abstracted problem and thus helping people to face the seriousness of food safety events [7]. For the relevant regulatory authorities, the application of OLS and PSM methods not only prevented the occurrence of micro and small GM food safety incidents, but also greatly reduced the chance of risky incidents; for the public, their daily dietary safety was better guaranteed, and the problems of GM protein recombination and high toxic element content were solved, which fully verified the practical value of GM food safety event response mechanism.

4.3 Coordination of Practice Measures

In order to maximize the protection of people's daily dietary needs, some new production processes, such as micronutrient extraction and protein transcoding behavioral intervention, can be introduced in the process of handling GM foods. In the face of GM food safety incidents, we should uphold the principle of fair and rigorous handling, and implement the processes of food sampling and GM process analysis in a step-by-step manner; for the extracted food samples, we should verify the validity of the GM ingredients they contain in accordance with the constraints of the OLS method and PSM method, and resolutely avoid toxic trace elements from entering the human body; for the incidents that have become safety hazards, we should adopt a positive attitude in dealing with them. For incidents that have become safety hazards, a positive attitude should be taken to deal with them, and no one should use any reason to cover up the true nature of the incidents, and strive to be fair and strict, and the relevant organizations must also rectify the possible GM food safety incidents, so as to eliminate the occurrence of GM food safety threatening incidents.

5 Conclusion

According to the existing research, the safety of genetically modified food has obvious long-term characteristics. The harmful effects on the human body and the external environment can last for a long time, and many secondary harmful behaviors will not be displayed immediately, but will show a long-term cumulative state. Therefore, when improving the response mechanism, attention should be paid to the following aspects:

(1) Improving risk assessment capabilities: When dealing with GM food safety incidents, the measures taken must have a certain level of assessment capability, and this assessment role should be comprehensive and multi-faceted, taking into account both the edible nutritional value of GM foods and the possible safety events caused by different foods.
(2) follow the principle of long-term follow-up: as the safety problems caused by GM food will not show up in a given time, when improving the response mechanism, we should try to lengthen the monitoring time line, so that on the one hand, the human body can better digest the GM food, on the other hand, we can avoid the adverse impact of emergencies on the safety of GM food.
(3) Prevention as the mainstay and cure as a supplement: to put forward higher requirements for the processing and production of GM food, to prevent enterprises and individuals from processing food indiscriminately, and to build a healthy relationship between food safety and people's daily dietary needs, so as to reduce the chance of GM food safety incidents.

In the future, relevant research units will also combine OLS methods, PSM methods and other analytical tools to evaluate the practical ability of GM food safety event response mechanisms. In addition, attention should be paid to the integrated relationship between GM food, production environment and human health, and the food safety assessment strategy should be improved while establishing an emergency response mechanism, which not only makes the safety should mechanism more forward-looking, but also can play an important role in influencing the deployment of long-term decision-making instructions.

References

1. Jiao Yue, Wang Zhi, Zhang Zhenmin et al. Exploring the threshold system of transgenic products in China based on the problem of low-level mixing of transgenic components[J]. China Agricultural Science and Technology Herald, 2022, 24(03):20–27.
2. Li Yani, He Xiaoyun, Xu Wentao et al. Small interfering RNA technology and its mediated safety evaluation of transgenic foods[J]. Journal of Food Safety and Quality Testing, 2020, 11(13):4150–4157.
3. Sheng Jiping, Wang Xin, Liu Yingxin et al. Effects of risk communication on college students' perception and acceptance of genetically modified foods: an analysis based on OLS and PSM methods[J]. China Food and Nutrition, 2021, 27(06):39–43.
4. Wu Jiali. A study on consumers' perception of safety risks of genetically modified foods: a sample of some consumer groups in Chengdu[J]. Journal of Food Safety, Quality and Inspection, 2021, 12(08):3410–3417.

5. Li Wenlong, Xu Junfeng, Xu Linjie et al. Exploration of good laboratory practice (GLP) for the safety management of agricultural genetically modified organisms in China[J]. China Agricultural Science and Technology Herald, 2021, 23(04):20–26.
6. Cui Bo, Lin Fangyu. Analysis of public attitudes toward the risks of genetically modified foods and their causes: a study based on virtual ethnography[J]. Popular Science Research, 2020, 15(03):37–47+60+110.
7. Fang Jun, Qu Jiaming, Zhang Aijun et al. Establishment of a standard system for assessing the effectiveness of emergency response to food safety emergencies: a Delphi consensus study[J]. Food Industry Science and Technology, 2022, 43(10):16–22.