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Fa-Gasvm Evaluation on the Safety of Genetically Modified Organisms Causing People's Psychological Anxiety — Empirical Evidence from China

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Abstract:

At present, there are two views on the safety of gm technology. One holds that GM technology destroys the balance of the original nature and has unpredictable impacts on the ecological environment; the other holds that some foreseeable or potential hazards can be avoided by means of biosafety. In China, the public is most worried about the damage gm food will cause to human health. In the past decade, as the number of GM food has increased, more and more Chinese people have been troubled by GM food, and some of them have even experienced great psychological pressure. Under the influence of COVID-19, with the development of animal and plant genetic engineering in China, the role of genetically modified organisms is becoming more and more important. This paper analyzes the existence of the inverse system, identifies the initial inverse model by FA-GASVM, optimizes the parameters of the SVM by GA algorithm and generates the inverse model then, combines it with FA, and FA is introduced while the GASVM inverse is the main controller of the adaptive system. The forecasting results of FA-GASVM, FA-GASVM are compared, which indicates that FA-GASVM has more excellent performance than GASVM in forecasting biological safety of genetically modified. The study found, when the training set (test) sets is 19/20 base on GASVM, in the same training set and test set of the same, the biological safety of genetically modified quality evaluation of mean square error (MSE=0.9213, operation time was 129.528 S, the correlation coefficient is 96.0091%.FA-GASVM in the same training set and test set of the same, the mean square error (MSE = 0.8801, the running time of 123.399S,the correlation coefficient is 98.0725%. The FA-GASVM model is proved to be effective in optimizing parameters of SVM. Based on the proposed FA-GASVM, support vector machine parameters were optimized in this paper, which significantly improved the prediction accuracy of support vector machine in biosafety evaluation. At the same time, we need to use scientific thinking methods to guide the public to understand GM food; Educating the public about science; Building and maintaining trust among the public, government and scientists; Let the public freely choose genetically modified food, correctly guide people to genetically modified food health psychological treatment.

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***Keywords**: Evaluation; Biological safety of genetically modified(GM); FA-GASVM; COVID-19; Psychological Anxiety*

I. INTRODUCTION

The genetic engineering of plants and animals is looming as one of the greatest and most intractable environmental challenges of the 21st century. In 1946 scientists discovered that DNA can transfer between organisms. Since genetically modified mice in 1980, transgenic technology in animals has made great strides progress, especially in livestock and poultry breeding and biological reactor. With the expansion of the applications of transgenic animals, transgenic animal insecurity research has gradually entered into people's field of vision [1].

The debate over GM continues in China, where there is a general lack of trust in scientists and government regulators working on GM research. Chinese consumers often doubt whether GM food is safe? Chinese people will still have psychological pressure when they see GM food.

As of 1983 the first genetically modified plant was produced which used antibiotic-resistant tobacco. Since 1996, food commercial cultivation of genetically modified (that is GM) crops has growing fast. Total area of crop planting area is 125 million hectares in 2008 which is equivalent to 74 times that of 1996. At the same time, the debate surrounding genetically modified food whether security has never stopped. The topic has been become the focus of scholars, public concern and discussion. Evaluation of the safety of genetically modified food has become one of the most important problems. In 2013, corn is genetically engineered, as are roughly 85% of corn, 91% of soybeans, and 88% of cotton produced in the US are genetically modified. For 21 biotech crops in the world's countries, our country's area of genetically modified crops ranked fifth which behind only the United States, Argentina, Brazil, Canada.

Biological safety concept has two level of narrow and broad, the biological safety of narrow usually refers to the research, development, production of the GM and transgenic products from the whole process to the practical application of questions about human health and ecological environment security. Generalized biological safety refers to man-made environment of dramatic change and impact on biodiversity and threats in a specific time period [2]. According to the definition of the United Nations food and agriculture organization, biological safety refers to avoid infectious organisms or genetic organism and to human health and safety and the protection of environment. At present developed countries has been applied in the practical management the general connotation of biological safety, and quarantine as an important part of its national biological safety.

Chinese people will still have psychological pressure when they see GM food. Transgene is the transplantation of gene fragments into target tissues such as animals, plants or microorganisms through special genetic technology. Not only science and technology produce benefits, but also uncertainty,

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potential disasters and side effects [3]. In China, the public is worried that genetically modified food will damage human health, damage the ecological environment, cause farmers' bankruptcy and affect international trade, but the most worried is the harm of genetically modified food to human health. The public believes that genetically modified food is against nature and is worried that eating genetically modified food will cause cancer, lead to infertility, damage human organs and loss of immunity.

In China, during the past 19 years, the cultivated areas of genetically modified crops have increased by an average of 10％ annually. Evaluation on biological safety of genetically modified is increasingly in the spot light. In 1990, China established the quality control standard of genetic engineering products. In 1993 China issued a "genetic engineering safety management method". The ministry of agriculture approved the measures for the administration of agricultural genetically modified organisms safety evaluation in 2001. For the end of 2005, our country has accepted the 192 research units of 1525 safety assessment at home and abroad, approved 456 genetically modified organisms, 181 large-scale biological experiments and 424 items security certificate.

Caimenglong study the influence of super ovulated program, species, number of embryos transferred and season which is aimed to improve preliminary transgenic progeny for biological safety assessment of genetically modified sheep [4]. Xin-yuan SONG, Xin-fang ZHANG, Zhuang YU, Xin-hai LI, Ming ZHANG believe that a reliable environmental bio-safety assessment system is an important component in the process of transgenic crop commercialization. DENG Xin, ZHAO Ting-Chang, GAO Bi-Da, ZHANG Yong-Jun, SUN Fu-Zai introduced the related biosafety assessment research was emphasis on gene flow, insects resistance and management. Process evaluation is research, development and commercialization of GM food as well sales and consumption of the whole process of dynamic comprehensive detection and safety assessment, mainly including product research and strict laboratory toxicity, irritability and resistance experiment [5]. Based on this idea, process evaluation methods is very strict for the safety of genetically modified food evaluation in the European Union countries.

At present, there are many evaluation methods used to evaluate on biological safety of genetically modified, such as fuzzy evaluation, analytic hierarchy process (AHP), gray predication, and so on, which play appositive role in the evaluation of biological safety of genetically modified [6]. But they also have disadvantages such as the factors are not comprehensive and the result is imprecise. In recent years, support vector machine (SVM) is introduced into financial fields due to good performance and generation capability. Support vector machine developed by Vapnik et al., is a new and promising technique for classification and regression and has been proved to be competitive with the best available learning machines in many applications. Through the study, SVM can automatically find the support vectors that have well distinguish ability for classification. Hence, we employ SVM for credit scoring. Since the optimal parameters search of SVM plays a crucial role in building a prediction model with high accuracy and stability. However, there is no general guide for determination of parameters. In general, SVM’s parameters are searched by grid-search method and a number of

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experiments, which are obviously time-consuming. Genetic algorithm is a general adaptive optimization search methodology based on natural selection and natural evolution.

In this paper, we explore a new approach----genetic algorithm which determined the optimal parameters of SVM. The proposed GA-SVM model was tested on a personal data set. Since this study is concerned with finding out optimal values of SVM parameters whose values are unknown, GA is well-suited to manipulating this optimization problem. To design an effective SVM model, a kernel function and parameters of SVM have to be selected carefully in advance. This paper analyzes the existence of the inverse system, identifies the initial inverse model by FA-GASVM, optimizes the parameters of the SVM by GA algorithm and generates the inverse model then, combines it with FA, and FA is introduced while the GASVM inverse is the main controller of the adaptive system.

II. MATERIALS AND METHODS

2.1 The Principle of Evaluation on Biological Safety Base on FA-GASVM

The founder of support vector machine, V. Vapnik began to study the statistical learning theory as early as 60s. Support vector machine invented by V. Vapnik in the nineteen nineties, is a machine learning algorithm based on statistical learning theory. SVM is a set of supervised learning techniques intended to solve discrimination problems (i.e. to decide which class a sample should belong), or regression problems (i.e. to predict the numerical value of a variable) [7]. SVM method is established based on VC dimension theory and minimum structure risk principle of statistic study theory. The basic idea of SVM is for the linearly separable samples, to find the optimal classification hyper plane which can separate accurately the samples into two categories.

Support vector machine solves linear inseparable in the original space x by mapping the original variable into a high dimensional space. And in the high dimension space, finding based on structural risk minimization. SVM has more cases applied in classification. The classifier constructed by this may maximize the interval between the classes, and has good generalization performance and higher accuracy rate. The introduction of non negative slack variables and the penalty factor C, the optimization problem can be expressed as improving the generalization ability of support vector machine by the structural risk minimization principle, SVM has a set of visual and good classification ability, linearly inseparable samples of low dimensional space will be mapped to high dimensional feature space by a nonlinear transformation of kernel function and construct the optimal hyper planes and decision function in low dimensional space.

2.2 The Steps of Implementing Genetic Algorithm and Support Vector Machine (That is FA-GASVM).

Factor analysis (that is FA) method was put forward in 1904 by British psychologist Charles Spearman which is a statistical method that is based on the correlation analysis of multivariable. Factor

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analysis method which is to reduce multiple variables to a lesser number of underlying factors that are measured by the variables is a statistics method which changes several test indexes into few comprehensive indexes. Factor analysis can find less comprehensive variables which can reflect as much original variable information as possible among many variables of test data by several variables' related factor matrix or covariance matrix. The steps of factor analysis are that making original variable standardized, and analyze the relativity of variable, variance anglicizing, looking for factor loading matrix, making variable factor by rotation method, calculating the score of variable factor and comprehensive evaluation according to the score.

GA differs from conventional heuristic methods in that it can deal with large search spaces efficiently and is unlikely to get local optimal solution. Recently, genetic algorithms have been widely and successfully to applied to various optimization problems. Genetic algorithm uses selection, crossover, and mutation operators to generate the offspring of the existing biological safety of genetically modified[8]. In this paper, GASVM is applied to evaluate on biological safety of genetically modified. In the GASVM approach, GA is used to select suitable parameters for SVM classifier. When GA solves optimal problems, the relative real valued parameters or variables can be directly used form a chromosome, unlike traditional binary genetic algorithms which must be translated into binary codes. The training parameters C, s and e are represented by a chromosome. Randomly generate an initial population of chromosomes [9]. However, there is no obvious functional relationship between learning performance and parameter C support vector machine. Therefore, the global searching characteristic of genetic algorithm can effectively support vector machine parameters. Genetic algorithm is a kind of method to search the optimal solution by simulating the process of natural evolution, it initially by Professor J. Holland Michigan of the University of American first proposed in 1975 which is a kind of search algorithms that can be used in complex system optimization with robustness.

Compared with the traditional optimization algorithm, the traditional optimization algorithms tend to deal directly with the actual value of the decision variables, and the genetic algorithm can imitate biological genetic and the genetic algorithm can intimate biological genetic and evolutionary mechanism of nature and regarded fitness as the search information directly, without derivatives and other auxiliary information. After the processing of comprehensive evaluation of biological safety of genetically modified, we transmit it to the evaluation in order to achieve the evaluation results of GA-SVM. The comprehensive evaluation method of biological safety of genetically modified based on the FA-GASVM is not that construct plane on the sample directly, but carry out FA transform on the sample, then we use GASVM to transform the training samples in order to get the optimal hyper plane to classify samples. The principle of genetic algorithm and support vector machine (GASVM) is as follows:

Step1 With the encoding parameters and initializing population of parameter, the two parameters C, s and e were directly coded to form the chromosome. Generate real-coded initial population of

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chromosome randomly.

Step2 According to the coding of the feature subset of each chromosome, forming the training data and testing data.

Step3 Decode each chromosome to obtain corresponding values of parameter C and γ . According to the penalty factor C, s and e, training and testing the training data and testing data by Support vector machine to calculate cross-validation classification accuracy (i.e. fitness function).

Step4 Determining whether they meet the final ratio condition, if they meet the final ratio, exiting the loop, ending genetic optimization and performing calculation by putting optimization parameters into SVM, or back to step6.

Step5 Crossover operator and mutation operator will be executed. Here the matching degree of crossover probability and mutation probability is self-defined before algorithm. Thus forming a new generation of individuals, and returning to step2 to continue the implementation of optimization algorithms.

Based on regression arithmetic of SVM, support vector machine with FA genetic algorithm (FA-GASVM) is proposed to evaluate on biological safety of genetically modified, in which FA, genetic algorithm (FAGA) is used to determine the training parameters of support vector machine.

2.3 Evaluation on Biological Safety of Genetically Modified Based on FA-GASVM

2.3.1 Evaluation index system

The biosecurity assessment of the genetically modified crops is a complex systems engineering, and the assessment index system should include all aspects of the activities of the supporting units. To analyze the factors affecting genetically modified organism, follow the scientific, systematic, operational and dynamic principles in the construction of the index system, and refer to the research results of the genetically modified organism, preliminary design of the Genetically Modified Organism Security Evaluation Index system. Through expert investigation, select the support capability evaluation index system of aviation material support units, as shown in TABLE I. In order to improve the operation speed and generalization ability of the prediction model, the original data must be normalized before constructing the training sample set, using the genetically modified crops data as the research data.

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TABLE I. INDEX OF BIOLOGICAL SAFETY OF GENETICALLY MODIFIED.

TOXICITY ASSESSMENT			ALLERGIC TO EVALUATE				ANT NUTRITIONAL FACTORS			
toxicity assessment which protein is material	toxicity assessment which all agricultural products for the material	Gm contain insect-resistant crops remaining toxins	The target sequence homology of proteins with known allergen	The target protein with known allergy patients serum IgE of immune reaction	Characteristics of the evolution of the target protein to digest	Foreign proteins tolerance of pepsin digestion	The accumulation of a foreign compounds in gm food	The change of metabolism	Resistance to gm food	Food nutrition change
0.99	0.87	0.99	0.99	0.99	0.93	0.97	0.96	0.97	0.97	0.67
0.98	0.90	0.13	0.21	0.21	0.95	0.17	0.25	0.30	0.34	0.84
0.97	0.89	0.16	0.11	0.11	0.94	0.06	0.12	0.09	0.09	0.60
0.95	0.77	0.16	0.21	0.21	0.96	0.17	0.25	0.16	0.15	0.62
0.99	0.91	0.19	0.31	0.31	0.96	0.17	0.33	0.28	0.22	0.51
0.89	0.89	0.15	0.21	0.21	0.93	0.17	0.25	0.27	0.20	0.56
0.98	0.76	0.26	0.34	0.31	0.91	0.19	0.29	0.30	0.35	0.68
0.93	0.90	0.20	0.21	0.21	0.96	0.17	0.25	0.28	0.14	0.81
0.89	0.86	0.13	0.19	0.19	0.91	0.22	0.19	0.20	0.23	0.84
0.94	0.85	0.18	0.21	0.21	0.96	0.17	0.25	0.40	0.29	0.92
0.92	0.88	0.37	0.37	0.35	0.91	0.99	0.38	0.43	0.44	0.79
0.84	0.82	0.14	0.21	0.21	0.96	0.17	0.25	0.24	0.10	0.67
0.81	0.81	0.18	0.13	0.13	0.91	0.08	0.20	0.37	0.17	0.82
0.91	0.91	0.12	0.21	0.21	0.99	0.17	0.25	0.10	0.14	0.98
0.96	0.91	0.23	0.41	0.27	0.91	0.12	0.71	0.22	0.16	0.53
0.90	0.90	0.08	0.21	0.21	0.97	0.17	0.25	0.97	0.13	0.85
0.82	0.80	0.04	0.07	0.15	0.91	0.05	0.04	0.04	0.03	0.50
0.99	0.99	0.07	0.21	0.21	0.98	0.17	0.25	0.08	0.06	0.73

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0.92	0.92	0.03	0.10	0.16	0.91	0.03	0.01	0.01	0.01	0.22
0.94	0.93	0.03	0.21	0.21	0.70	0.17	0.25	0.01	0.02	0.25
0.93	0.93	0.05	0.07	0.07	0.91	0.01	0.07	0.06	0.05	0.64

Index of biological safety of genetically modified includes three aspects which include toxicity assessment, Allergic to evaluate and ant nutritional factors. Toxic substances are those produced by animals, plants and microorganisms to other species of toxic chemicals. From the chemical point of view, toxic substances, including almost all types of compounds, in terms of toxicology, the toxic substances can be generated to various organs and targeted direct role of chemistry and physical chemistry, and cause various adverse physiological effects of the body. The establishment of animal model to evaluate the safety of genetically modified food is very important. Animal experiment is one of the most commonly used method of food safety evaluation, the toxicity evaluation immune toxicity test of gm food, nerve toxicity, carcinogenicity and the establishment of genetic toxicity and so on. Insect-resistant transgenic organisms contain toxins from the crop residues and the activity of protease inhibitors both can make a bite to eat the leaves of insect digestive system function damage, also has the possibility of damage for human.

The international food biotechnology council with the international life science institute of allergy and immune research institute developed an analysis with the genetic modified food allergic tree analysis method. It mainly analyzes the source and target protein of gene sequence homology with known allergens, target proteins with known allergy patient's serum IgE can happen in the reaction, and the physical and chemical characteristics of the target protein. Food allergy is a worldwide public health problem. The world has nearly 2% of adults and 4% ~ 6% of children have food allergies In genetically modified (gm) food allergic evaluation, the first to determine the source of the protein, amino acid sequence of proteins with known of the trigger between the sequence of amino acids are remarkably similar. The protein's structure characteristics include its effect on enzyme degradation, the hot stability or susceptibility to acid treatment and enzyme treatment.

Comparing the genetically modified product with similar traditional parental genotype varieties nutrient composition differences, include crude protein, carbohydrates, fats, fiber, vitamins, minerals, nutrients and anti nutritional factors is an important part of genetically modified food safety evaluation. Of genetically modified food nutrition evaluation focuses on protein, starch, cellulose, fat and other closely related to human health and nutrition substances.

2.3.2 Evaluation on biological safety of genetically modified base on FA-GASVM

From TABLE II, results show that when we take the five principal components, the cumulative percentage is 94.1009%. To measure biological safety of genetically modified, it is needs to use multiple indicators, it often needs to reflect biological safety of genetically modified of multiple variables of the development level of a large number of data collection. Although large sample can

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provide to scientifically evaluate a wealth of information, but there may be a correlation between many variables in many cases. The statistics reflect the letters overlap to a certain extent, the scientific nature of the impact assessment.

By comparing the predicted results of biological safety of genetically modified, with the actual results, we find that they are very close, which indicates that the training set obtains relatively good penalty factor C and kernel function. The curve of MATLAB simulation result of biological safety of genetically modified is shown in Fig 1.

TABLE II. RESULTS OF FACTOR ANALYSIS.

NO	EIGENVALUES	PERCENTAGE%	CUMULATIVE PERCENTAGE%
1	6.8088	56.7401	56.7401
2	1.8403	15.3356	72.0757
3	1.334	11.1165	83.1922
4	0.7201	6.001	89.1933
5	0.5889	4.9076	94.1009
Principal factor number M=5			

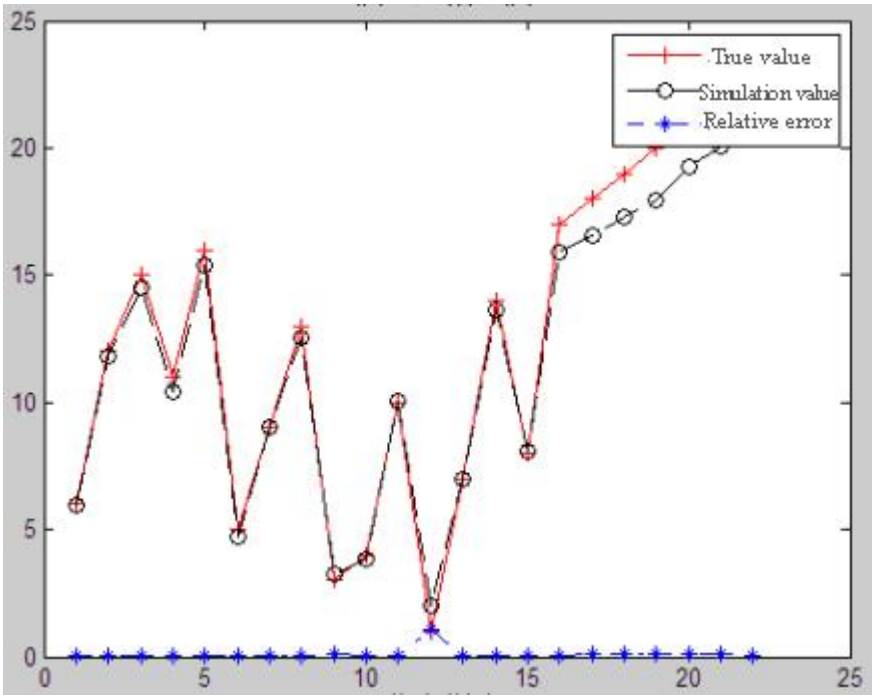

Fig 1: Simulation result of biological safety of genetically modified based on FA-GA-SVM.

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TABLE III. COMPARISON OF THE FORECASTING RESULTS AMONG GA-SVM AND FA-GA-SVM.

	TRAINING/TEST	ACCURACY RATE	RUNNING TIME
GA-SVM	19/20	MSE=0.9213	129.528 S
	19/18	MSE=0.4702	126.528 S
	19/17	MSE=0.4602	125.528 S
FA-GA-SVM	19/20	MSE=0.8801	123.399 S
	19/18	MSE=0.2780	121.879 s.
	19/17	MSE=0.2604	119.879 s.

From TABLE III, results show that in terms of evaluation accuracy of biological safety of genetically modified, FA-GASVM evaluation has higher accuracy and faster convergence speed than that of GASVM. Through FA, data of valuation of biological safety of genetically modified can greatly reduce the complexity of the training model and the storage space, which sped up the training speed of SVM and obtained satisfactory results. Choose 20,18,17 as test samples, the training sample is the same 19, FA-GASVM combining biological safety of genetically modified quality evaluation of the accuracy is high, and its training time is short,

As shown in TABLE I, the training data is used to construct training sample sets according to the dimension of the input vector. Here, the suitable parameters for the GA-SVM model of forecasting biological safety of genetically modified are illustrated as follows, C =25.04, s =1.05,e =0.0072. Mean absolute percentage error is used to evaluate the forecasting accuracy. As shown in TABLE II, the forecasting results of FA-GASVM, FA-GASVM are compared, which indicates that FA-GASVM has more excellent performance than GASVM in forecasting biological safety of genetically modified. For example, when the training set (test) sets is 19/20 base on GASVM, in the same training set and test set of the same, the biological safety of genetically modified quality evaluation of mean square error (MSE =0.9213, operation time was 129.528 S, the correlation coefficient is 96.0091%.FA-GASVM in the same training set and test set of the same, the mean square error (MSE = 0.8801, the running time of 123.399S,the correlation coefficient is 98.0725%. The FA-GASVM experiment is conducted on the MATLAB. Moreover, the results also implied that the prediction accuracy of SVM was increased by using the optimal parameters based on the proposed real-value FA-GASVM. But the accuracy gained by proposed model is a time-consuming process through adjusting the SVM parameters. In addition, the predefined searching precision of FAGA affected the running time.

III. CONCLUSION

This study introduces a novel approach, which combing a real-valued FA with GA-SVM model for biological safety evaluation. The FA-GASVM model is proved to be effective in optimizing parameters of SVM. The prediction accuracy of SVM in biological safety evaluation is obviously increased by

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optimizing SVM parameters based on the proposed FA-GASVM [10]. Moreover, the proposed FA-GASVM model is still provided a reference for biological safety of genetically modified. With further exploring of these models for biological safety, biological safety evaluation system will benefit greatly from these models and develop rapidly. FA-GASVM is applied to forecast biological safety of genetically modified in this study. In the FA-GASVM model, GA is used to select suitable parameters of SVM, in which the leave-one-out method is determined to evaluate fitness [11]. FA-GASVM can achieve greater forecasting accuracy than artificial neural network, grey model in biological safety of genetically modified. The experimental results show that classification accuracy of FA-GASVM are superior to those of SVM classifiers whose parameters are selected by experience. Experimental results reveal that the FA-GASVM model achieved higher accuracy than those of other exiting classifiers, such as GA-SVM methods. The FA-GASVM model is proved to be effective in searching the optimal parameters of SVM. The proposed hybrid system has a potential for biological safety evaluation in terms of prediction accuracy and generalization ability.

The Chinese government encourages the genetic engineering technology and gm products research and development work, also attaches great importance to the safety of genetically modified food. The relevant state departments have issued a genetically modified food safety management regulations, and measures. In 2001, the state council promulgated the regulations on the administration of agricultural genetically modified organism's safety. In March 2002, the ministry of agriculture issued a series of management method of genetically modified organisms and gm foods. However, genetically modified food in our country there is bull management, department coordination is not high faults. So, still need to further improve the food hygiene law system in our country, to strengthen the safety assessment of genetically modified food related legal responsibility.

New Crown Disease has increased the demand for plant-based foods. In the case of new crown pneumonia, it is imperative to ensure food safety. In view of the serious new corona virus epidemic situation, the attention diet safety is prevents and controls the epidemic situation is the very important measure. It is of great significance to study the biological safety of genes. We call on people all over the world to give high priority to the bio safety of genes in the face of coVID-19.

With the development of the research and application of transgenic technology, the planting area of transgenic crops is increasing year by year. At the same time, the public has a distrust of GM technology and its applications, and of scientists and government departments engaged in GM research. From the perspective of social psychology, the reason for the public distrust of genetically modified food lies in the following: the social debate on genetic modification has shaken the public trust, and the narrative of genetic modification has destroyed the public trust, face information affects public trust, and fear of transgenic technology exacerbates public distrust. There are three ways to regulate the public's distrust of genetically modified food: to strengthen the scientific popularization of GMO knowledge, to strengthen the rational dialogue on GMO disputes, and to strengthen the correct guidance to the society.

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Of course, we need to guide the public to recognize genetically modified food with scientific thinking methods; Popularizing science to the public; Establish and maintain the trust between the public, the government and scientists; Let the public choose genetically modified food freely and correctly guide people's healthy psychological treatment of genetically modified food.

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