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Detection of Genetically Modified Foods Existence in Egypt Markets

Fatma Elzahraa, I. Abdel rahman, M. M. M. Bekhit[1]; M. S. Abdel Sabour[1]; T. A. Alakkad[1] and S. D. Ibrahim[2]
1. Dept. of Genetics and Genetic engineering, Faculty of agriculture, Benha University.
2. Agricultural Genetic Engineering Research Institute (AGERI), Agriculture Research Center, Giza, Egypt
Corresponding author: Makhlouf.bakhit@fagr.bu.edu.eg

Abstract

Analysis for some field crops, feed and food products found in the local markets of Egypt was applied for GMOs detection using molecular technique based on PCR. DNA was extracted from samples including three groups italic fresh samples (egg plant, guava, olive, mango, tomato, potato and orange), cereals and seed samples (wheat, barley, broad bean, chickpea, corn, lentils, lima bean, soybean) and food products (bechmel, beef, chicken soup, chips, feta cheese, indomie, jelly, popcorn and powder milk), followed by tests to ensure purity of DNA samples using specific primers. GMO detection in the studied samples was conducted using specific primers for the most commonly used genes in genetic transformation such as 35S promoter from Cauliflower mosaic virus and Nopaline synthase terminator (T-Nos), using the following plasmids as positive control: PGIIMH35S-g2ps1 and pBI221. Tests revealed existence of GMOs in some imported products such as pudding, Jelly, popcorn and sauce due to the presence of 35S promoter and NOS terminator in soybean, while tests showed negative results in the local crops tested.

Key words: Genetically modified foods, GMO, 35S promoter, Egypt

Introduction

With the advent of the age of plant genetic engineering and with the first experience to production Flavr-Savr tomatoes which released commercially in 1994, The start of global and research interest in increasing crops produced by genetic engineering to overcome many of the problems faced some crops as well as increasing the productive efficiency of many crops **(Yuan *et al*., 2018)**. Currently, we can say that the increase in the area planted with GMOs was in the last few years similar to the explosion. The area planted with GMOs today reached about 189.8 million hectares worldwide in 2017. About 80% of GMOs represent the main part of food and feedstuff, such as soybean, corn and rapeseeds **(Becker and Ulrich, 2018).** According to some statistics, more than 40% of corn, more than 50% of cotton, more than 45% of soybean and at least two-thirds of all U.S.A food products contain GMOs **(Qian *et al*., 2018).** Until November 2018 there are 498 GMOs are approved in 30 crops in 44 nations for cultivation with 46 varieties, 229 maize cultivars, 61 cotton cultivars, 40 soybean cultivars and 48 potato cultivars **(ISAAA, 2018 and Gao *et al*., 2019).**

Globally, there are more than 50 nations and regions have fortified control and management of GMOs and release GMOs labeling regulations **(Li *et al*., 2019)**. GMOs were allowed in the United States, Canada and Argentina widely. By contrast, the situation was completely different in the European Union (EU) and there a conclusive rejection and strict official legislation to the GMOs **(Briefs, 2017 and Sánchez-Paniagua *et al*., 2018).** This indicates that the safety of GMOs is still indecisive, so different threshold labelling levels were set in different countries to vary from 0 to 5 %. Some of them were obligatory (e.g., Australia, Brazil, Chile, China, EU, India, etc.), others were optionally (e.g., Canada, Argentina, U.S, etc) **(Qian *et al*., 2018).** The EU is one of the first to show clear opposition to GMOs globally and the consequent development of strict regulations and laws to track GMOs from the field to the counter. To protect the consumers freedom of choice, the European Union has approved obligatory labeling of food or feed to denote it as GMOs **(; Regulation, 2003a; Regulation, 2003b andGao *et al*., 2019)**. While GMOs bring us great benefits, their prospective risks stay controversial. These arguments can be summarized as two parts of life health and environmental safety, including whether it is toxic, whether it will cause gene drift, whether it is sensitized, whether it will produce antibiotic resistance and whether it will destroy biodiversity, etc**(Fraiture *et al*., 2015 and Fraiture *et al*., 2017).** It should be noted that EU and US legislation and regulations are the yardsticks for developing countries that do not have specific regulations that define a specific approach to dealing with genetically modified foods.

On a local scale, as reported by **James (2015)** the situation of the production of genetically engineered crops in Egypt is still in the research phase and experimental and has not yet reached the adoption and generalization GMOs area in Egypt does not exceed 1% in comparison with USA 43% and Brazil 19% they are the largest countries to production GMOs globally.

Therefore, the biggest challenge for researchers is to find and update accurate methods for detecting GMOs. Recently, there are many complex multistage

which based on PCR have been established for detection and scanning of GMO. Initially, screening experiments target specific DNA sequences which studies have referred to that use often in plant transformation. If the results are positive, after screening must be some construct-specific assays are don, and then event-specific identification and quantification of the GMO **(Holst-Jensen *et al*., 2003; Waiblinger *et al*., 2010 and Becker and Ulrich, 2018;)**.

At present, many studies mentioned that the most regulatory elements which widely used are the 35S promoter and NOS terminator have been used considerably to regulate expression of targeted transgenes with current commercialized GMOs by more than 86.3%. The 35S promoter derived from cauliflower mosaic virus (CaMV) as a primary target in GMOs screening which is found in approved GMOs by at least 65% and higher than that in commercially important transgenic crops (about 126 GMOs events). and the NOS terminator which isolated from nopaline synthase gene (NOS) of *Agrobacterium tumefaciens,* and newly used with about 90 GMOs events. So, these elements are used often to screening GMOs and routine screening strategies for GMOs **(Hull *et al*., 2000; Oraby *et al*., 2005;Kok *et al*., 2005;Wu *et al*., 2014; Datukishvili *et al*., 2015; Gao *et al*., 2019 and Li *et al*., 2019).** Therefore, the study was planned to detect the genetically modified foods directly obtained from the markets in Egypt.

Materials and methods:

Samples collection:

In our study, there was a great challenge for the team to develop a sampling plan due to the great variety of food samples in the Egyptian market of foreign origin or imported foodstuffs from abroad which are likely to be genetically engineered. Therefore, the sampling strategy was developed to include the division of the samples to be grouped into three groups, each of which had similar characteristics: the fresh food group which included 30 samples, the grains and seeds group which included 35 samples and finally the processed food group which included12 samples. So that samples are collected from three governorates, namely, Cairo, Qalyubia and Menoufia governoraste. This is due to the fact that these three provinces are a major center for the production and distribution of fresh and processed foodstuffs to the rest of the Egypt.

Table 1. Samples of three groups (G1, G2 and G3) collected from different location in Egypt.

G1. Fresh samples	G2. Cereals and seeds	G3. Food products
Berry	American wheat	Bechamel
Courgette	Arugula	Beef
Dates	Barley seeds	Chicken Soup
Eggplant	Broad bean seeds	Chips
Guava	Bulgarian wheat	Feta cheese
Lemon 1	Celery seeds	Indomie
Lemon 2	Chickpea	Jelly
Loquat	Coriander seeds	popcorn
Mallow	Corn	Powder milk
Mango	Courgette seeds	Powder milk
Moringa	Cowpea seeds	Pudding
Olive 1	Cucumber seeds	Sauce
Olive 2	Dill seeds	
Orang 1	fenugreek seeds	
Orange 2	Leek seeds	
Orange 3	Lentils	
Papper 1	lima bean	
Papper 2	Luffa seeds	
Papper 3	Lupin	
Plum	Mallow	
Pomegranate	mallow seeds	
Potato	Parsley seeds	
Purslane	peas seeds	
Radish	Polish wheat	
Squash	Popcorn	
Sweet potato	Radish	
Tangerine	Russian wheat	
Tomato	Soy bean 1	
Watercress	Soy bean 2	
Watermelon	Spinach beet seeds	
	Spinach seeds	

	Tomato seeds Turnip seeds Ukrainian wheat Watermelon seeds

Table 2. Plasmid names which used as positive in this study

Plasmid name	The genetical constitution of the plasmid
PGIIMH35-2PS1	35S pro+T-NOS+….+….
pBI-221	35S pro+T-NOS+….+….

DNA Extraction method:

Despite there are many methods used in the separation of DNA, we adopted in this research the method according to **Porebski et al. (1997)** with some modifications. Taking into consideration the respect the scientific requirements in terms of standardization of the weight of the samples in proportion to the total solids of the sample, good homogenize and the unify all factors that may affect the accuracy of the results obtained.

Estimation of DNA concentration:

The DNA concentration was estimated after extraction by depending on a Nanodrop UV/Vis spectrophotometer and agarose gel methods. All DNA samples were quantified using Nano-drop method according **Healey *et al.* (2014).** the quality was also measured by running 2 µl of the DNA extracted from each sample understudied on 0.7% agarose gel in comparison to 5µl of a DNA size marker (100bp DNA ladder). To estimate DNA concentration, compare the degree of fluorescence of the DNA sample with the different bands in DNA size marker **(Oraby *et al.*, 2005 and Wang and Fang, 2005)**.

Reproduction of DNA by using PCR device.

PCR reactions: the PCR amplification reactions were carried out as mentioned by **Oraby *et al.* (2005)**. Reactions were performed in 25 µl volume composed of 1x reaction buffer, 0.2 mM of dNTPs, 1.5 mM $MgCl_2$, 0.2 µM of each primer, 1 unit of Taq polymerase and 40 ng of template DNA, in sterile distilled water.

Thermocycling profile and detection of the PCR products: PCR amplification of the DNA was performed in a Perkin Elmer thermal cycler 9700 programmed to fulfill 42 cycles. The temperature profile in the different cycles was as follows: an initial strand separation cycle at 94°C for 5 minfollowed by 40 cycles comprised of a denaturation step at 94°C for 1min, an annealing step at 36°C for 1 min and an extension step at 72°C for 2 min. The final cycle was a polymerization cycle for 7 min at 72°C.

GMO scanning: PCR products were loading by electrophoresis in a 1.5% agarose gel containing ethidium bromide (0.5 mg/ml) in 1 x TBE buffer at 120 volts. A 100bp DNA ladder was used as molecular size standard. PCR products were visualized under UV light and documented using a ™XR+ Gel Documentation System (Bio-Rad).

GMO screening methods:

In this study, we depend on the most favorable candidates for screening GMO method according to **Ruttink *et al.* (2010),** promoter (35S) and terminator (NOS) sequence. The cauliflower mosaic virus (CaMV) 35S promoter and the nonpalin synthase (nos) terminator are the common genetic elements in most genetically modified foods worldwide **(Alasaad *et al.*, 2016)**

Table 3. Primer sequences and size of amplification products

Primer	Sequence 5'-3'	Amplicon length (bp)	Annealing temp (◦C)	Reference
35S promoter	AAAGATGGACCCCCACCCAC GAGGAAGGGTCTTGCGAAGG	195 or 390	54	**Blake et al. (1991)** **Oraby et al. (2005)**
NOS terminator	CTGTTGCCGGTCTTGCGATGAT CCGCGCGCGATAATTTATCCTAG	180	54	**Hemmer (1997)** **Oraby et al. (2005)**

Results and discussion

So far, Egypt has not effectively acceded to international conventions that criminalize and prevent the circulation of genetically engineered foods that are not known to consumers. It has not been so far just letters from the Egyptian government to international organizations and recommendations from the latter to Egypt's accession to the World Trade Organization as a state that prohibits the trade of genetically engineered foods without a statement of GMO products to maintain its consumers and provide greater safety. Egypt is one of the countries importing food and crops with 60- 70% of its annual consumption. Despite the growing global interest in the detection of genetically engineered foods and the development of standards and legislation to regulate the world trade market accordingly, the entry of

imported food in Egypt depends only on the food nutrition content and limits allowed for fungal and toxins without concern that the food is a genetic engineer or Not **(Khidr *et al*., 2018).**

Extraction and amplification of DNA:

In order to ensure the realistic results of the samples used depending on the DNA fraction, this requires high precision and careful care in extracting, processing and purifying DNA molecules and making them suitable for complete experiment. The DNA fragment is affected by many factors that may lead to DNA amplification failure, such as compounds associated in the sample such as proteins, sugars, fat, polyphenols and chemicals such as CTAB. Not only that, there are other challenges that are the common food processing steps like grinding, mixing, extraction, refining or heating which can lead to an obstacle in getting the desired results optimally. Due to the large differences in the target samples, it is necessary to determine the optimal strategy for extracting and purifying DNA according to the type of sample. As it is no doubt that the best strategy for fresh samples may not suitable with the samples manufactured and so on. The CTAB protocol has a qualitative advantage with fresh samples compared to manufactured samples to obtain the best DNA properties. This protocol needs to be some modifications with processed foods to achieve the required properties in the extracted DNA.

DNA concentration (ngµl^{-1}):

In previous studies, there are many methods that studied to extraction of DNA **(Rogers and Bendich, 1985; Hemmer, 1997; Porebski et al., 1997; Jankiewicz et al., 1999; Son et al., 2009 and Sönmezoğlu and Keskin, 2015)**, but in our study we were focus of the most accurate method to decrease the variation factors. DNA concentration and yield as in **Table (4)** showed that if we take an overview of the three groups, we will notice that the fresh sample was the highest amount of DNA generally, then the cereals and seeds and the lowest group was food products group. The fresh sample group give average 675.77ngµl^{-1} despite the extreme contrast between samples. The highest five concentration were Courgette (326 ngµl^{-1}), Mango (1409 ngµl^{-1}), Moringa (1385 ngµl^{-1}), pomegranate (1164 ngµl^{-1}) and Watermelon (1099 ngµl^{-1}). While, the lowest five concentration were Dates (13 ngµl^{-1}), Guava (75 ngµl^{-1}), Olive1 (110 ngµl^{-1}), Purslane (119 ngµl^{-1}) and Olive2 (123 ngµl^{-1}).

In second group (cereals and seeds samples) showed that the average of DNA concentrate was 544.60 ngµl^{-1}, it is significantly less than first group (fresh samples). The highest samples were rapeseeds (1909 ngµl^{-1}), Soy bean2 (1740 ngµl^{-1}), Broad bean seeds (1733 ngµl^{-1}), Cowpea seeds (1646 ngµl^{-1}) and Mallow (1581 ngµl^{-1}). On the other hand, the lowest samples were Lentils (43 ngµl^{-1}), Coriander seeds (46 ngµl^{-1}), Watermelon seeds (102 ngµl^{-1}), lima bean (108 ngµl^{-1}) and Celery seeds (136 ngµl^{-1}). Quite differently, the third group (food products) gave the lowest results, the third group average was 78.97ngµl^{-1}. The highest samples were Feta cheese (350 ngµl^{-1}), Sauce (121 ngµl^{-1}) and Indomie (114 ngµl^{-1}). While, the lowest sample showed a significant decrease, Pudding (0.2 ngµl^{-1}), Jelly (2.4 ngµl^{-1}) and Bechamel (22 ngµl^{-1}). From previous results we note that, there are many reasons which lead to decrease of DNA concentration after amplification in PCR, by other meaning the extracted protein not able to amplification. In view of the previous studies **(Anklam *et al*., 2002 and Gryson, 2010)**, we find that many researchers touched on this subject explaining the reasons that may lead to this case. Perhaps one of the most striking reasons and most influential is heat treatments for samples during dehydration for cereals and seeds after harvested or heat processing for food products. These results are consistent with many previous studies such as **Oraby *et al*. (2005)** who mentioned that the concentration of the DNA extracted by the CTAB dependent method ranged from 86 to 1650 ng µl^{-1} in the tested samples. Concentration of the DNA extracted by using the kits ranged from 300 to 3100 ng µl^{-1}. There are various factors that may contribute to the quality of the PCR products, such as the purity of the DNA extracted from the sample and the size and homogeneity of the sample. A representative sampling of any lot is also vital in attaining accurate results.

Table 4. DNA concentration

G1. Fresh samples		**G2. Cereals and seeds**		**G3. Food products**	
Sample	**Conc.(ng µl^{-1})**	**Sample**	**Conc. (ng µl^{-1})**	**Sample**	**Conc. (ng µl^{-1})**
Berry	598	American wheat	834	Bechamel	22
Courgette	326	Arugula	502	Beef	30
Dates	13	Barley seeds	138	Chicken Soup	51
Eggplant	902	Broad bean seeds	1733	Chips	32
Guava	75	Bulgarian wheat	165	Feta cheese	350
Lemon	483	Celery seeds	136	Indomie	114
Lemon 2	602	Chickpea	1209	Jelly	2.4
Loquat	461	Coriander Seeds	46	popcorn	65

Table 4 Cont.

Mallow	831	Corn	347	Powder milk	76
Mango	1409	Courgette seeds	358	Powder milk	84
Moringa	1385	Cowpea seeds	1646	Pudding	0.2
Olive 1	110	Cucumber seeds	262	Sauce	121
Olive 2	123	Dill seeds	265		
Orang	819	Fenugreek seeds	393		
Orange 2	379	Leek seeds	147		
Orange 3	466	Lentils	43		
Papper 1	834	Lima bean	108		
Papper 2	466	Luffa seeds	165		
Papper 3	551	Lupin	509		
Plum	178	Mallow	1581		
Pomegranate	1164	Mallow seeds	154		
Potato	412	Parsley seeds	162		
Purslane	119	Peas seeds	597		
Radish	558	Polish wheat	242		
Squash	154	Popcorn	404		
Sweet potato	978	Radish	706		
Tangerine	274	Russian wheat	281		
Tomato	967	Soy bean 1	870		
Watercress	603	Soy bean 2	1740		
Watermelon	1099	Spinach beet Seeds	314		
		Spinach seeds	357		
		Tomato seeds	334		
		Rapeseeds	1909		
		Ukrainian wheat	302		
		Watermelon seeds	102		
Average	675.77		544.60		78.97

Screening of Genetically Modified Foods in the Egypt Market:

Screening of first group (fresh food samples):

Vegetables and fruits are grown worldwide and make up a major portion of the diet of humans in many parts of the world. They play a significant role in human nutrition, especially as sources of vitamins (C, A, B1, B6, B9, E), minerals, dietary fiber and phytochemicals. Vegetables and fruits in the daily diet have been strongly associated with improvement of gastrointestinal health, good vision, and reduced risk of heart disease, stroke, chronic diseases such as diabetes, and some forms of cancer **(Keatinge et al., 2010 and Ryder, 2011)**.

A world vegetable survey showed that 402 vegetable crops are cultivated worldwide, representing 69 families and 230 genera. Leafy vegetables of which the leaves or young leafy shoots are consumed were the most often utilized (53% of the total), followed by vegetable fruits (15%), and vegetables with below ground edible organs comprised 17%. Many vegetable crops have more than one part used. Most of the vegetables are marketed fresh with only a small proportion processed because most vegetables are perishable. Consumption shortly after harvest guarantees optimal vegetable quality **(Dias and Ortiz Rios, 2014)**.

Through the results obtained for the first group, which includes the fresh samples of a random group of fruits and vegetables collected from several different places and after repeated tests several times. The results indicated the absence of any positive results with NOS terminator **as in Figure (1)** or 35S promoter **as in Figure (2).** To the best of our knowledge and reading, the number of researches conducted to detect genetically modified fresh vegetables and fruit is Very limited. Although, the earliest genetic modification experiments were for vegetables such as tomatoes and potatoes**. According to (Kramer and Redenbaugh, 1994 nd Dias and Ortiz Rios, 2014;),** the first commercially grown transgenic crop was FlavrSavr tomato, which was released by **Calgene in 1994**. This tomato contains an antisense version of the polygalacturonase (PG) gene. The use of this gene ensued after many years of research on several genes involved in fruit development and tomato ripening. They were identified, cloned, and characterized to breed transgenic tomato cultivars. However, FlavrSavr tomato failed in the market since this cultivar was considered inferior by growers and was rapidly withdrawn from the market. Plant genetic engineers learned an important lesson after this failure: the importance of cooperation with plant breeders. But here we should point out that when we examined

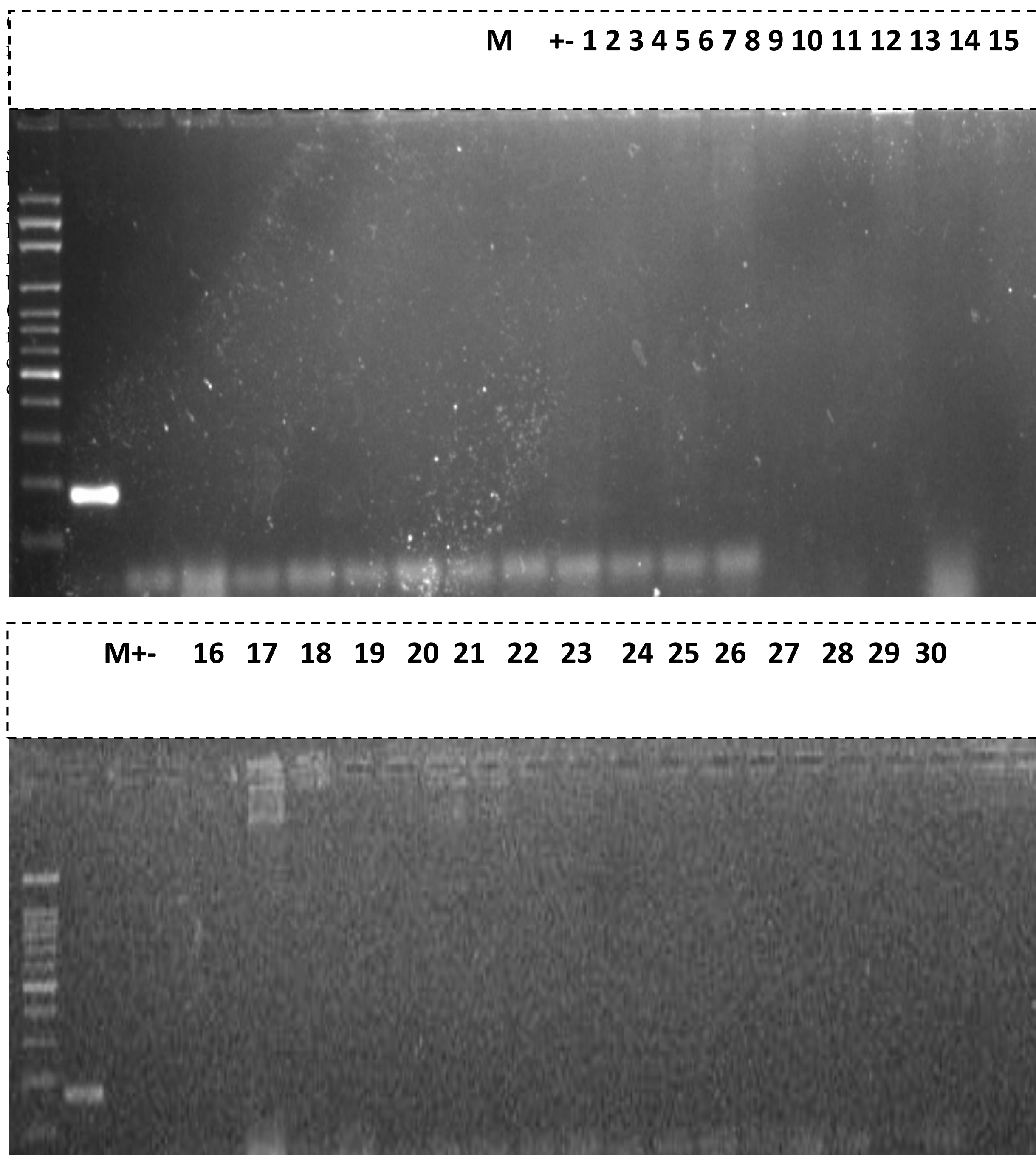


Fig (1): Detection of NOS terminator segment in fresh samples; with positive indicator(+), negative indicator(-) and M (Ladder 100 bp).

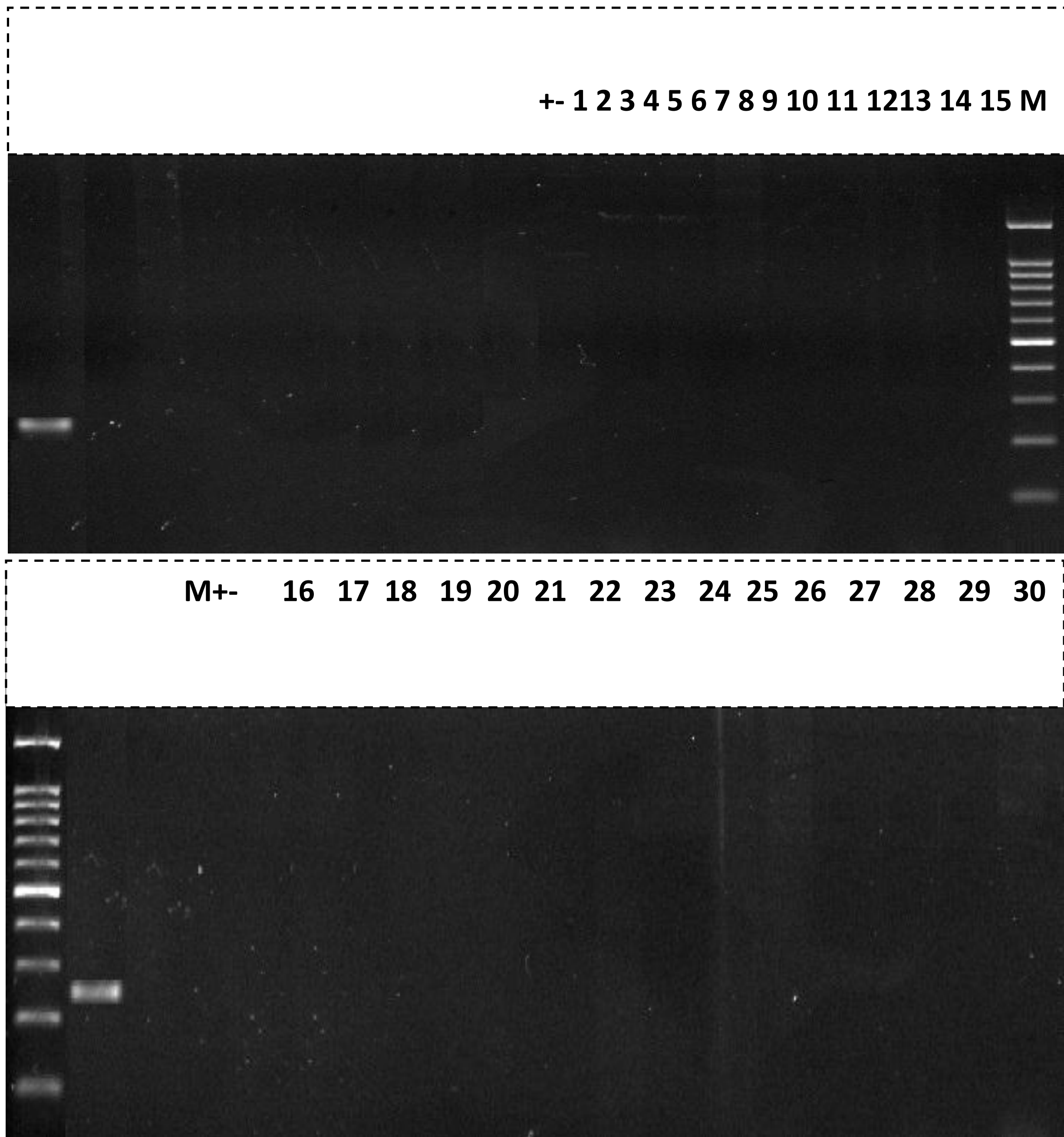


Fig (2): Detection of 35S promoter segment in fresh samples; withpositive indicator (+) , negative indicator (-) and M (Ladder 100 bp).

Screening of second group (cereals and seed samples):

The second group aimed to study a group of the most common food materials in the diet for all age groups whether directly used or as raw or secondary raw material in many food products and processed foodstuffs. In order to achieve the purpose of this study, the samples of this group were collected from the largest grain and seed stores in Cairo and a larger number of the other two groups. Although the beginning of genetic engineering targeted vegetables as already mentioned, cereals and seeds have taken the greatest interest in the following stages and now some genetically engineered cereals and seeds are grown in some countries by 100%.

The results indicated the absence of any positive results with NOS terminator as in **Figure (3)** or 35S promoter as in **Figure (4)**, this is despite the widespread proliferation of genetically engineered crops, which account for cereals and seeds with the largest share. According to **Viljoen *et al.* (2006)**GM crops accounted for 29% of global crop production, it is estimated globally that 56% of soybean, 28% of cotton, 19% of canola and 14% of maize is GM.

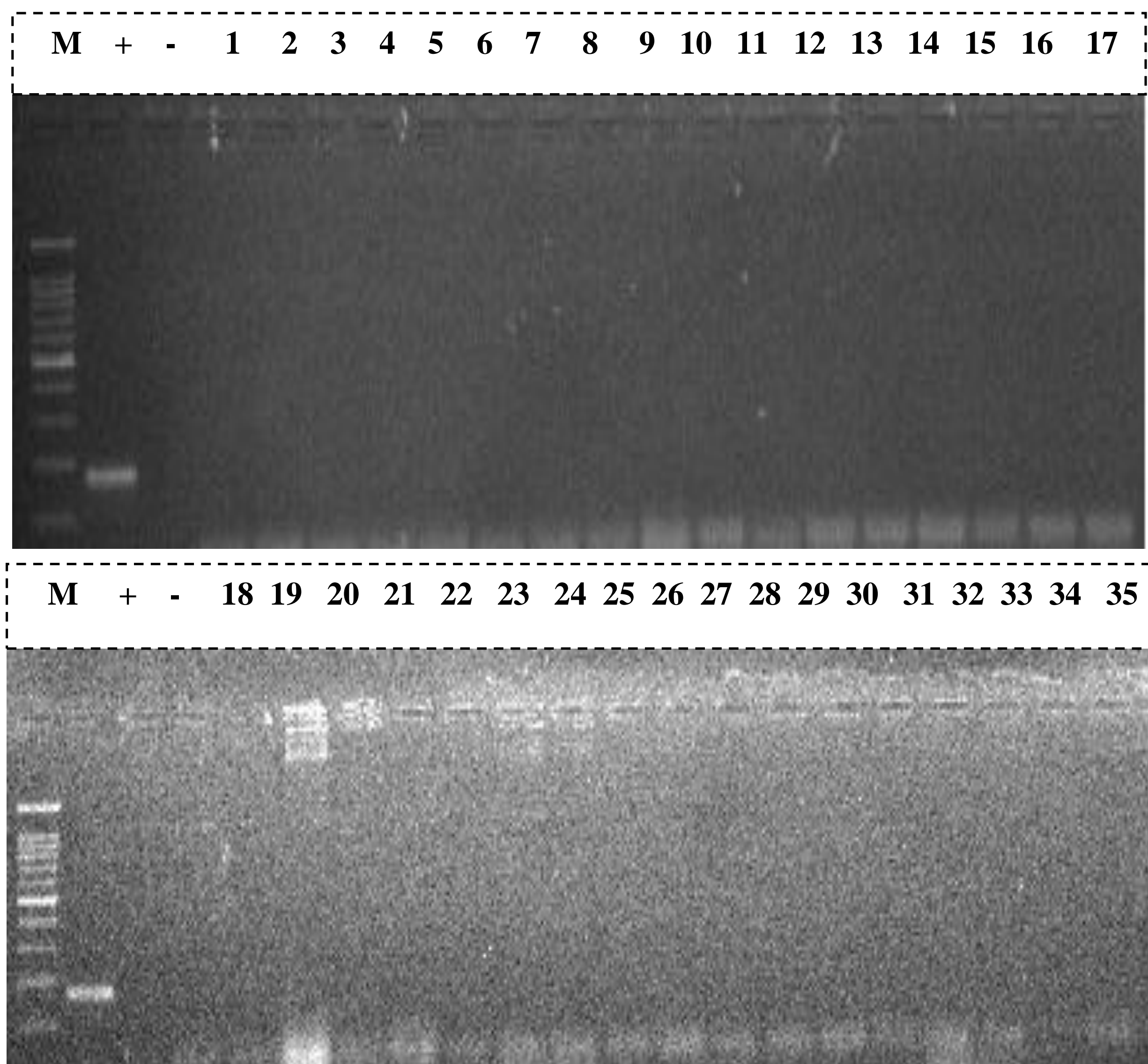


Fig (3): Detection of NOS terminator segment in cereals and seed samples; with positive indicator (+), negative indicator (-) and M (Ladder 100 bp).

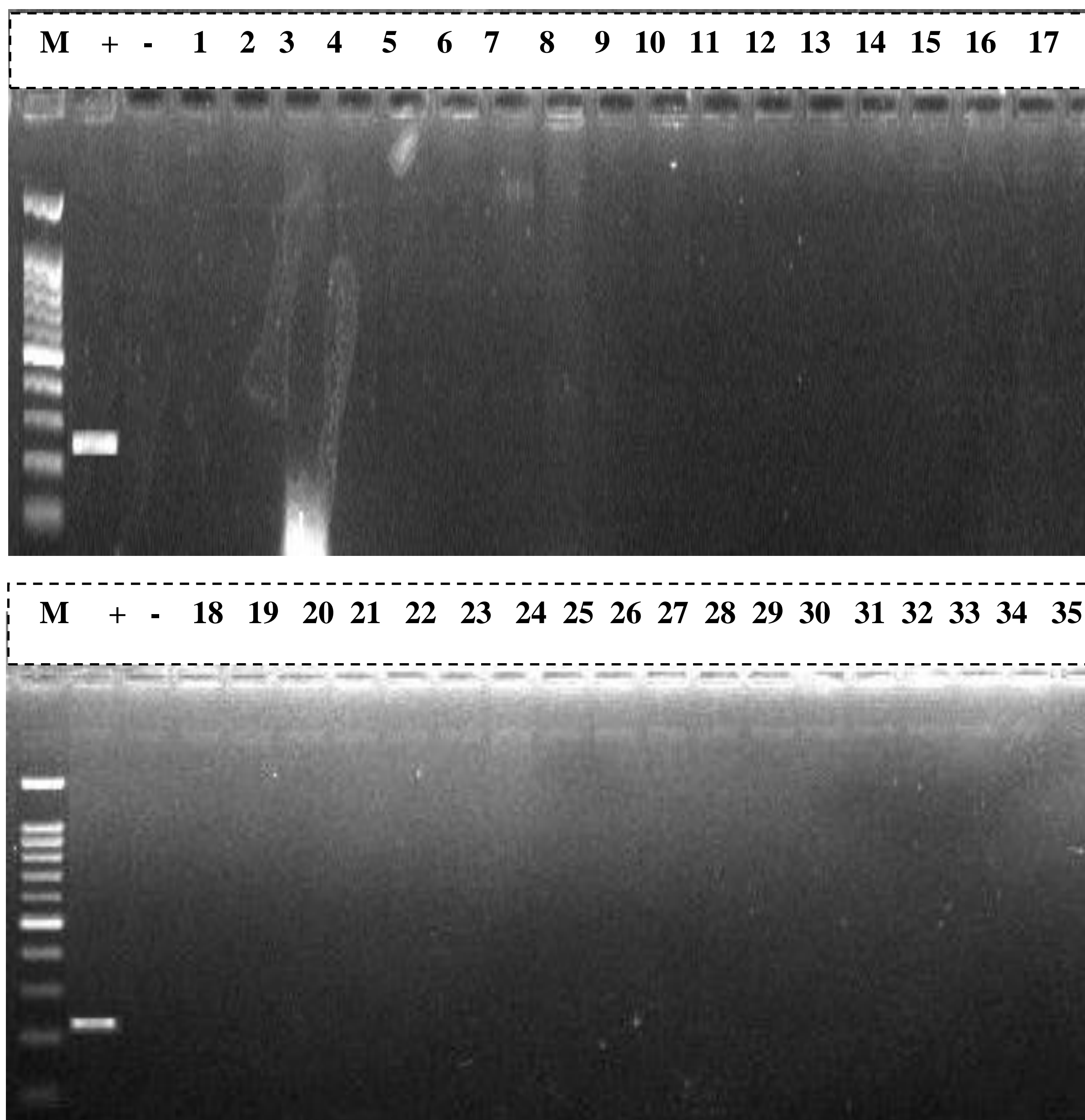


Fig (4): Detection of 35S promoter segment in cereals and seed samples; with positive indicator (+), negative indicator(-) and M (Ladder 100 bp).

Screening of third group (food products):

The availability of genetically engineered products in manufactured products increases because many products enter into their manufacture and thus increase the chance of having a more genetically modified gene component. In this group, the research team selected the imported food products to detect the genetically modified sequence. to provide a kind of safety and tranquility to the consumer for consumed the imported products.

The results as in **Figure (5 and 6)** which showed that there are **four** samples given a positive result with **NOS terminator** as in **Figure (5 and 7)** and **Table (4)** which represent 33% of the samples tested in third group. NOS terminator test showed a clear visible band at 118 pb with some imported samples like Pudding (Turkey), Jelly (United Arab Emirates) and popcorn (European Commission), which means that these samples are genetically modified using NOS terminator. On the other hand, there is one product which manufactured in Egypt (Tomato Sauce) is given a positive result with NOS terminator which due to there are some imported material or raw seeds used in producing this product. Whereas, there are some other samples which not have been shown any visible bands in NOS terminator range (118 pb), which mean that these samples are not genetically modified using NOS terminator. These samples contain some samples manufactured in Egypt like Powder milk, Chicken Soup, Indomie and Feta cheese, also there are some imported sample like Chips (Malaysia) and Beef (Brazil). Egypt is considered one of the countries that does not commit to the development of mandatory data on food packages that indicate whether they are genetically engineered or not. Despite the many risks expected from the use of genetically engineered materials , as has been mentioned in many studies around the world, which led to the adoption by some countries of reservations on the use of genetically engineered food or at least mandatory labeling indicating that food is a genetic engineer to ensure the right of the consumer to determine the selection of the use of genetically engineered foods or not to use them **(Fraiture *et al*., 2017; Gao *et al*., 2019 and Sánchez-Paniagua *et al*., 2018)**. therefore, it was expected to find a lot of imported food genetically engineered. As our results NOS terminator (nopaline synthase gene of *Agrobacterium tumefaciens)* is widely used as a genetically engineering element for one or more of food product ingredients for the products which manufactured in Egypt by using imported ingredients, there are two products that give positive result with NOS. Indomie product which have brand (Indomie) it is made in Egypt by Indofood Indonesian Company. This product is manufactured mainly from wheat flour, in our country, only about 40% of the annual consumption of wheat is produced domestically and is entirely directed to subsidized bread production, while private sector companies rely on imported wheat, including pasta and indomie producers **(Veninga and Ihle, 2018)**.according to this result, there are about 45-55% of wheat and wheat flour in Egyptian markets are GMO by a certain percentage. The second positive GMO product manufactured in Egypt by some imported ingredients was Bechamel mix which manufactured by Helou El Sham Company. This product made by wheat flour, corn starch, soy protein, vegetable oil, salt and flavours. As it is known both of wheat flour, corn starch and soy protein are imported from different countries, therefore, these three ingredients are responsible for giving this positive result of GMO. The third positive GMO product manufactured in Egypt was Sauce product. On the other hand, the imported products which, given a positive GMO with NOS terminator were as flowing; i. Pudding product which manufactured in Turkey by Basak company, Basak company exports to Egypt more than 10 kinds of different products (by examining products in the market during sampling). In this study, we examined one product of the company's products and gave a positive result, and this raises a kind of concern about the other products produced by this company in terms of containing genetically modified materials. ii. Jelly product which manufactured by Greens UK company, imported from United Arab Emirates (UAE) and these products are available in the Egyptian market in many types of most types of instant sweets such as Semolina, Cake mix, White outs, Corn flour, Cheese cake, Carmella and dessert whip. iii. Popcorn product, which made by Bright star company in European Commission (EC) and imported by Nahrain for food Industries Company, this product is written free GMO. The main ingredient in this product is corn which, is the reason why there is a positive result of GMO.

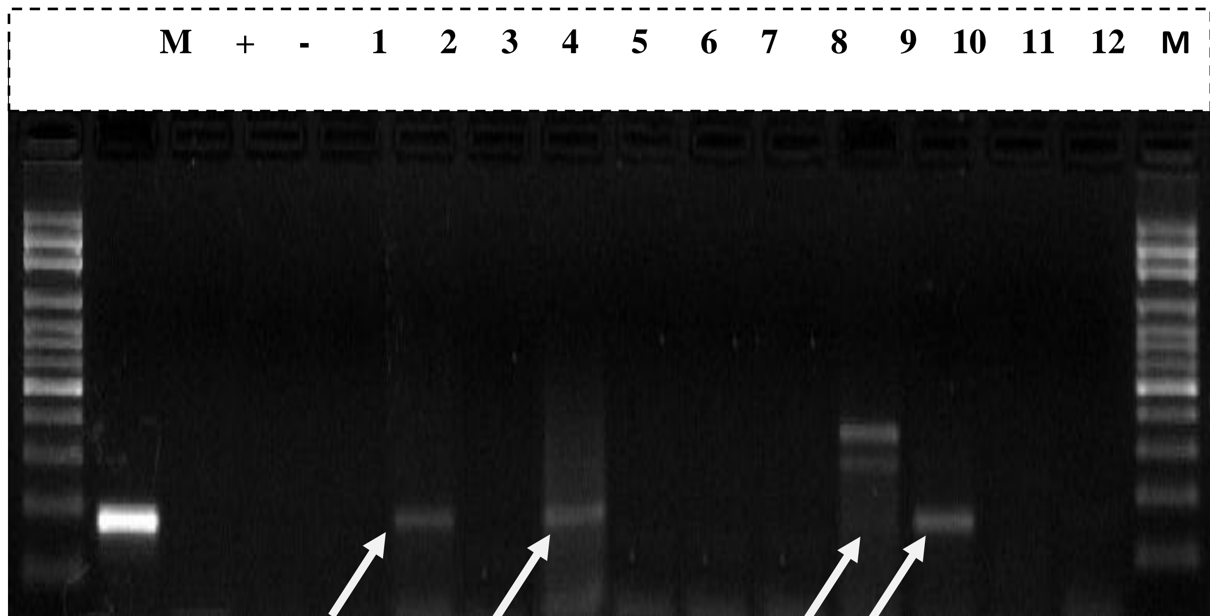
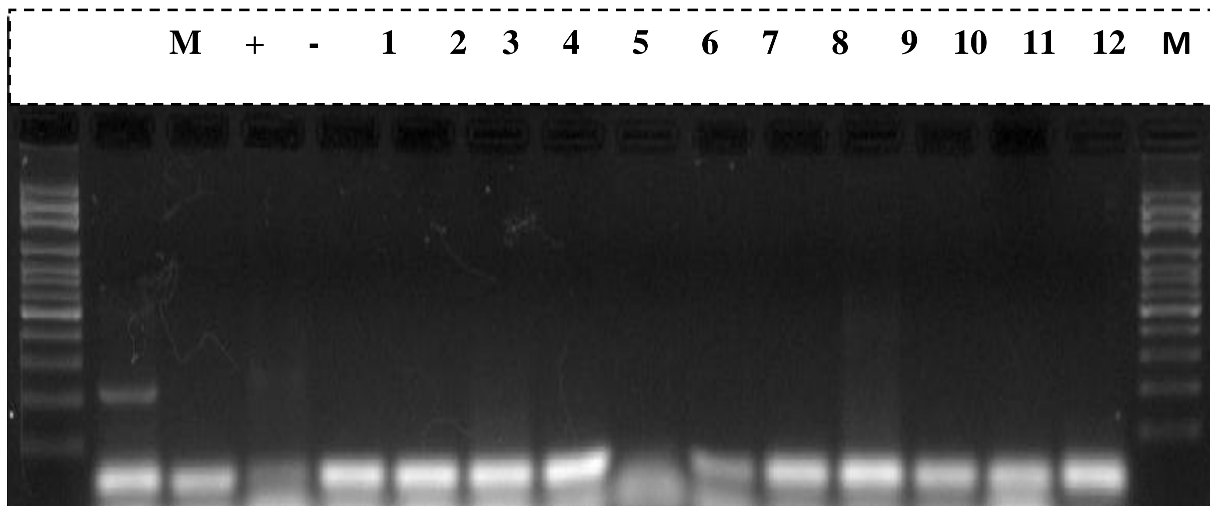


Figure (6): Detection of NOS terminator segment in food products samples; with positive indicator(+), negative indicator(-) and M (Ladder 100 bp).



Fig(5): Detection of 35S promoter segment in food products samples; with positive indicator (+), negative indicator (-) and M (Ladder 100 bp).

Table 4. Revealed the detected GMOs in the local markets of Egypt.

Sample code	Sample	Brand	Origin state	Detection	
				NOS	35S
PR 1	Powder milk	Milky gold	Egypt	Not detect	Not detect
PR2	Powder milk	Mirro	Egypt	Not detect	Not detect
PR3	Pudding	Custard	Turkey	**Positive**	Not detect
PR4	Bechamel	Ethery Queen	Egypt	Not detect	Not detect
PR5	Jelly	Jelly	UAE	**Positive**	Not detect
PR6	Chicken Soup	Chicken Soup	Egypt	Not detect	Not detect
PR7	Indomie	Indomie	Egypt	Not detect	Not detect
PR8	Chips	Chips	Malaysia	Not detect	Not detect
PR9	popcorn	Popcorn	EC	**Positive**	Not detect
PR10	Sauce	Sauce	Egypt	**Positive**	Not detect
PR11	Feta cheese	Cheesa	Egypt	Not detect	Not detect
PR12	Beef	Beef	Brazil	Not detect	Not detect

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الكشف عن وجود اغذية معدلة وراثيا في الاسواق المصرية

ا.د. مخلوف محمد محمود بخيت – ا.د. محمد سراج الدين عبد الصبور – د. تامر أحمد العقاد د. شفيق درويش ابراهيم
قسم الوراثة والهندسة الوراثية. كلية الزراعة. جامعة بنها قسم الوراثة والهندسة الوراثية .كلية الزراعة. جامعة بنها
قسم الوراثة والهنسة الوراثية .كلية الزراعة. جامعة بنها
معهد بحوث الهندسة الوراثية الزراعية (اجيرى) ,الجيزة .مصر

في السنوات الأخيرة ، تعرضت الكائنات المعدلة وراثيًا (GMOs) للتدقيق لأنها مرتبطة بالإمداد الغذائي البشري. يؤكد العلماء المشجعون للكائنات المحورة وراثياً على إمكانات الهندسة الوراثية كفائدتها المهمة للمجتمع ، على سبيل المثال ، زيادة المحصول أو تحسين الجودة واستحداث المقاومة للأمراض الفطرية والبكتيرية والفيروسية. ومع ذلك ، فإن تحذير الآخرين من استخدام الكائنات المعدلة وراثيا ، يمكن أن يسلط الضوء على صحة الإنسان وخاصة الحساسية ومقاومة المضادات الحيوية. كان هناك أيضا قلق بشأن القوانين الأخلاقية والاجتماعية للهندسة الوراثية. مقارنة بأوروبا ، لا تزال مصر خالية من الأغذية المعدلة وراثيا باستثناء المنتجات الغذائية المصنعة المستوردة. اليوم ، تم اختبار عينات من الغذاء الآن بشكل روتيني لمحتوى الكائنات المعدلة وراثيا. وتبين الدراسة نتائج اختبار أكثر من مائة من المنتجات الغذائية باستخدام PCR لمحتوى الكائنات المعدلة وراثيا. تم فحص محتوى الكائنات المعدلة وراثيا من الأطعمة المستوردة المختلفة ، مثل مجموعة الأغذية الطازجة بما في ذلك 30 عينة ، مجموعة الحبوب والبذور بما في ذلك 35 عينة وأخيرا مجموعة الأطعمة المصنعة (12 عينة)بما في ذلك خلال الفترة من 2017/2016 الى 2018/2017. من بين 77 عينة من جميع المنتجات التي تم اختبارها ، كانت أربع عينات إيجابية بالنسبة للكائنات المعدلة وراثيًا (محتوى أكبر من 5٪). بالنسبة لدولة مثل مصر التي تستورد كميات نسبية من المنتجات الغذائية ، لا بد من اختبار جودة وسلامة منتجاتها وكذلك إجراء دراسات مراقبة صحية.