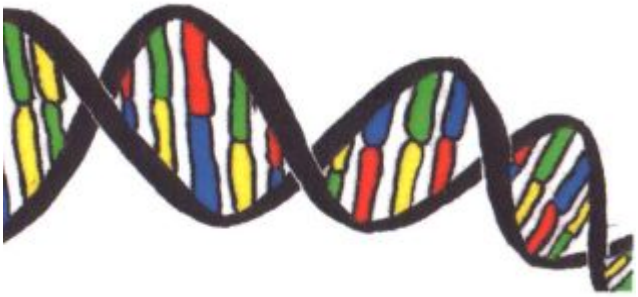
Future foods:



Pro GM? Or no GM?

One billion people in the world go hungry every day. But is genetically modified (GM) food the answer?

We've spent the last month investigating this question. In an exhibition of the Science Museum in London we've found powerful gut reactions to GM food.

While **Rob** felt GM crops could be the best option on the menu, they left a bad taste in **Raphaels's** mouth.

Now, you can explore the science, the ethics and the risks of GM food as we present our findings. See why Rob and Raph have both had to re-examine their views – and join this crucial debate yourself.

GM food – it's time to bite the bullet.

Genetic modification concretely
Effects on farming and nutrition

Learning at stations –
Instruction

By using genetic modification at farming and food, ecological, health related, economical and social political effects will be discussed. The complexity of this subject needs an interdisciplinary observation on the basic practice relevant position.

To deal with diverse themes time economical bears of a lasting learning success you may use the learning at stations.
At this method small groups of pupils are confronted with individual and concrete general topics. The work self-employed with prepared materials which are displayed at the learning-stations. The groups go from one station to the other.

Structure of materials and preparation

The second section of the teaching-concept has 16 learning stations which are useful in teaching. With the element-principle you can make a choice appropriate to your thematic main emphasis.

For the general biology lesson or for the teaching in the agriculture-section following stations are useful:

- How costumers are standing towards genetic modification?
- Genetically changed plants
- For whose benefit?
- The “golden” rice
- Surprise
- Turbo-performance
- Pest control in comparison
- Diversity is beauty
- The pollen is flying wherever it wants
- “With” or “without” genetic modification – peaceful side by side?
- Labeling

Also for the agriculture-section:

- Farming on the defensive

For the teaching in the section nutrition the following stations are useful:

- How costumers are standing towards genetic modification?
- Genetically changed plants
- Where can soy are found?
- Emulsifiers from the soybean
- Where can maize are found?
- For whose benefit?
- Functional food – the future trend
- The “golden” rice
- Surprise
- “With” or “without” genetic modification – peaceful side by side?
- Labeling

Choose compulsory stations which are essential to be worked on bay pupils and if necessary voluntary stations. The numbers of stations comply with the time you have. As we know, often the students use 2 to 2,5 hours without considering the time to talk about the results. To prevent working stops you should double the stations but you have to reduce the number of stations. List the names of your chosen stations. Get orientation from the pattern “station on overview” on the side after next. Every pupil gets an overall view with the walk sheet.

The first side of materials of each station has a diagonal division. On the underside at the yellow section you will find the questions for the pupils. On the top you will find compressed background information like advice of needed objects e.g. calculator and you will find the results. The following 7 sides are material to processing tasks. To start preparation you should cut off the exercises from the first site on the marked line and give it to the pupils. The material should be cut to working cards.

Build every station on a separate desk.

Phases of the stations learning

At the first talk the pupils get a brief glimpse of significant discussion points of the topic.

During the walk the pupils get to know the content of the stations.
Their learning-interest will be aroused.
The processing of the stations will be explained. Following points have to be observed:

- The pupils should have a paper and a pen.
- You go from station to station. The materials have to stay on their place.
- The pupils have to decide in which order the duty stations will be edited.
- Normally the yellow worksheet has to be read on each station first. So the pupils get notes for the task.
- The text should be read by a pupil of the group.
- The exercise should be finished by all the members of the group.
- You're not allowed to write on the materials at the stations.
- The results have to be noted by everyone.
- Every station must be abandoned so that the next group doesn't get the results. Also the cards will be remixed.
- If the work on the station is finished it will be check on a "walk sheet".
- The election sections just can be edited if the duty stations are finished.

For the work phase pupils are divided into a group of 2 to 4 persons. They work independently at the stations. The teacher can advise the group on individual difficulties. The methodologically very diverse stations deal with different learning input channels, which are for the most pupils an attractive learning.
The individual confrontation with the topic and the everyday-practical questions cause a very sustainable learning.
The own work- and learning pace can be realized on a fixed overall time.
The learning at stations gives pupils freedom for an independent and responsible learning.

In the evaluation phase pupils present their results. It should be space for a discussion. The teacher picks up important content and becomes absorbed in it. To save the results, the text and portrayal should be print on paper for every pupil.

Pro GM

Best thing since sliced bread?

Would we be mad to doubt GM technology?

Rob thinks that GM food offers benefits to health, nutrition, the environment and the developing world.
He sees no evidence that GM crops are unsafe to eat or to grow – and he feels the technology offers much more than traditional methods.
Rob feels we should encourage GM experiments now, so that future generations will reap the rewards.

But the contrasting viewpoint displayed opposite might challenge Rob's convictions. Take a look then test your own views in the next section.

No GM

Completely out to lunch?

Would we be mad to accept new GM technology?

Raph's not convinced that GM food has anything to offer that can't be achieved by clever new approaches and traditional methods.

He's concerned about the unknown risks of farming and eating GM crops, and the time it might take to find GM solutions-GM experiments.

But the contrasting viewpoint displayed opposite might challenge Raph's convictions. Take a look, then test your own views in the next section.

Functional Food – future trends?

For example:

Cereals with vitamin B supplement (1)

Muesli, whole wheat bread contain much vitamin B

For example:

ACE drinks with vitamin supplement (2)

Juices, fruits, vegetables Contain much vitamin A, C and more health – promoting substances

That is already produced genetically...

Functional Food:
Food with enrichments which promise health

That is supposed to be available in future with the aid of genetic engineering...

Natural Food:
with an unchanged variety of ingredients

Functional Food – future trends?

For example:

Rape with increased corotene content (3)

Green vegetables, carrots contain much carotene

For example:

Soya with high oil acid content (4)

Olive oil, rape oil are rich in oleic acid

(1) Various B vitamins are produced with the aid of genetic ally changed micro-organisms.
(2) Vitamin C and E can be produced by using genetic engineering.
(3) Rape is supposed to be changed genetically so that it contains more than a hundred times more beta carotene (prestage of vitmain A) than natural carotene comprehensive plants.
(4) Soybeans are supposed to be changed in that way that the oil acid content of the soy increases, and as a result they are favourable fpr people with increased blood fat – and blood cholesterol results.

Functional Food – future trends?

Almost all genetically engineered plants which can be found at the current market have one thing in common: they are equipped with agronomic features. These features promise to rationalize agricultural production. That isn't very attractive to consumers. The following "generations of GM technology" want to change this situation. Food that has an additional, positive effect on health, functional food, is held out in prospect. It is uncertain if such projects can be made ready for the market. In the past, different projects failed due to methodical problems, e.g. the attempt to produce allergen-free rice. Furthermore, there are a lot of open questions concerning the safety of genetically modified food for human health. Some of these products have no effect like, for example, vitaminised juice. According to the Heart Protection Study, vitaminised juice has no effect on mortality, heart attacks and cancer rate (The Lancet 260:23-33, 2002). Some products are even endangering health, in such a way that additions of isolated Beta Carotene cause more often lung cancer in heavy smokers and more deaths of people who suffer of cardiovascular disease (Caret-study: BMVEL-info 26:1, 2002).
Info: www.transgen.de; www.verbraucher.de/ernährung/functionalfood.html

Material: 3 information sheets

- The first two information sheets are about genetically engineered food that is currently available and about plants with functional food for the future. These sheets should be glued together on the narrow side to a survey.
- One information sheet with open questions and facts about functional food

Solution:
There are still lots of open questions concerning the use of functional food. These gaps in knowledge should be closed, before new products are put on the market. Furthermore there are enough conventional products which safeguard a healthy nutrition. The problem exists rather in eating habits than in a lack of healthy products.

Functional Food – future trends?

At present "functional food" is in fashion. They advertise with an alleged additional use for health. Genetic engineering is supposed to be of great importance for the new functional food.

Inform yourself on the basis of the outline "future trends". Get to know examples for "functional food" which already exist and will be produced with the help of genetic engineering in future.
Read the at present still unanswered "questions and facts".
Sum up a result and give reasons for your opinion:

Does it make sense to produce functional food for a healthy nutrition?

- **Yes, because...**
- **No, because...**

Which products contain maize?

In the most countries, corn is one of the important parts of the alimentation.
Out of maize you can make pancake, polenta or corn meal. Ca. 20.000 foods contain corn products.

Corn is one of the important providers for oil and starch in the food industry.
The growth market is the gaining of a wide range of sweeteners by saccharification of maize starch.
Europe is related on maize mostly a self- supporter.

GM modified varieties have been only grown in small scale in Spain. For the processing in food and animal food are different bug and herbicidal resistant sorts approved in Europe.

European countries import maize from the USA and Argentina.
The bulk of the offered maize (80% comes first over a corn) is in animal food. It contains maize, given to the animals and in the end of the food chain eaten by humans.

Material:

- flow chart
- three info cards corn flour, maize starch, oil and saccharification products
- four product cards with ingredients lists

Solution:

- pudding:
  - starch, glucose syrup, modified starch
- wellness bar:
  - glucose syrup, humectant sorbit, cornflakes, starch, veg-oil
- tortilla- chips:
  - maize meal, veg-oil, starch, maize shoot
- potato salad:
  - veg- oil, modified starch

Since a few years GM maize is used for the food production. Although there is no big market to import maize to Europe. But on the other hand Europe buys goods on the American market where from the food chain some GM sorts contained maize from the USA and Argentina.

Look at the images to maize processing. The maize grains will be processed; for example to maize meal, various sugar sorts and maize oil. In the ingredient list you can see, how the maize components are called.

Corn oil

The sprouts in the kernel of maize are very rich.

You can compress corn oil out of it.

It appeared in the ingredient list often only as vegetable fat, vegetable oil or plant oil.

Maize flour and maize starch

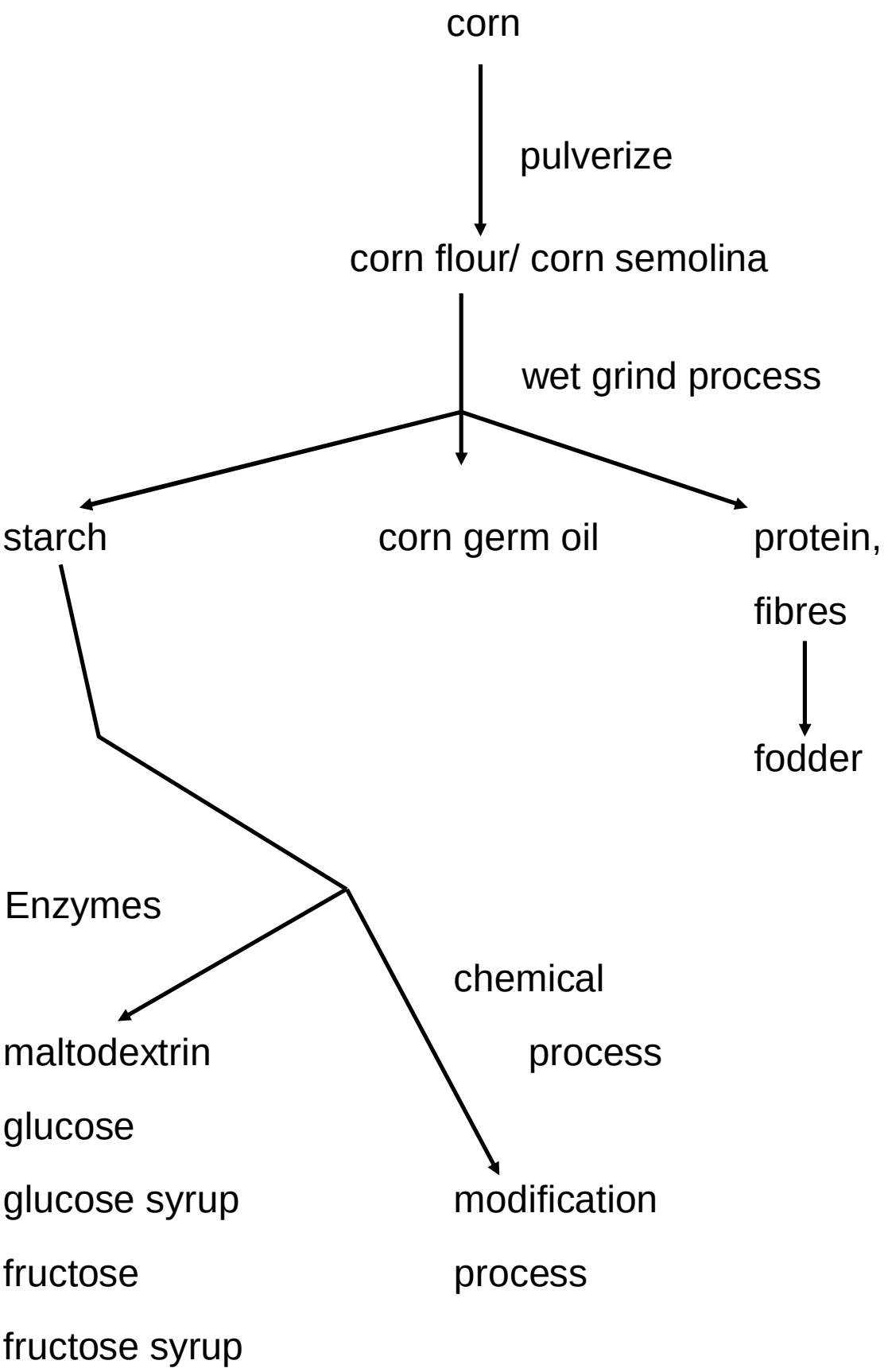
Products like polenta or cornflakes are produced from corn. Maize starch consists of maize flour, too. In the ingredient list is written: ’maize starch’, starch or modified starch.

Maltodextrin, glucose, fructose

With the aid of Enzyme you can split maize starch into fragments. It is the same as in our saliva.

Thereby and through other chemical transformation sugar substances are formed. They are called maltodextrin, glucose or glucose syrup, fructose or fructose syrup and sorbite.

Manufacture of corn



Ingredients:

Meal pudding:

sugar
starch
glucose syrup
modified
starch
cooking salat
aroma
colorimeter
(yellow orange)

Potato salad:

veg-oil
skim milk
yogurt
(modified
starch,
thickener : pectin)
water
sugar
onion
cucumber
spirit vinegar
modified starch
Dill
egg yolk
salt
lemon juice
natural aroma

wellness bar:

almond
apple extract
hazelnut
glucose syrup
milk chocolate
oat flakes
humectant Sorbit
cornflakes
starch
veg-oil
caramel
vanillin-aroma

Tortilla- chips:

maize meal
veg- oil
starch
salt
maize sprouts
sugar

Pro GM

Battling Bugs

Pests and diseases are a farmer's nightmare. But what is the best way to keep them at bay?

Instead of spraying crops with expensive and potentially hazardous chemicals, researchers are trying to create plants that resist problems by their selves.
Currently, farmers have to spray potatoes once a week to avoid the devastating late blight disease. But there are wild Andean potatoes that aren't affected by blight. If scientists can transfer their genes to other potato varieties in the lab, the GM super-spuds won't need spraying with fungicides.

No GM

Battling bugs

Pests and diseases are farmer's nightmare. But what's the best way to keep them at bay?

Instead of spraying crops with pesticides and fungicides, scientists in Peru are testing a cheap and safe alternative. They've released chickens into the local potato fields to eat up the Andean potato weevils – a notoriously damaging pest.

This method saves farmers money and time, and reduces the potential hazards of handling powerful chemicals.

Pro GM

Fewer fertilisers

A four-leafed clover is supposed to bring you luck. But scientists want to use clover's genes to improve farmer's fortunes and reduce fertiliser use.

Researchers have worked out that clover produces a natural fertiliser by tapping bacteria in its roots. The now hope to transfer clover genes into rice, creating a variety that produces fertiliser if its own.

Nitrogen fertilisers increase crop yields. But if rice contained a home-made fertiliser, it would save farmers money – and protect the environment from other chemicals.

No GM

Fewer fertilisers

For years farmers have known that the clever wild flower clover is a natural fertiliser. Sowing clover underneath crops increases nitrogen levels in the soil. This nugget of know-how helps to increase crop yields.

But now they're bringing another smart idea to the party. Satellite imagery can reveal which areas of land need a boost from nitrogen fertilisers to help crops grow properly.

By only using chemical fertilisers where they're really needed, farmers save money and help stop environmental damage.

Pro GM

The climate challenge

Growing crops is thirsty work. As our climate changes we'll urgently need plants that can grow well even when water is scarce.
One plant that copes in dry condition is moss – but it's not much of a tasty morsel. Researchers are exploring how to move a gene from moss into maize to make it thrive in a hotter, dryer climate.
The search for successful GM plants can take years but investment now could yield a new generation of hardy crops.

No GM

The climate challenge

Growing crops is thirsty work. As our climate changes, we'll urgently need plants that survive even when water is scarce.

To speed up the search for plants that will thrive in dry conditions, researchers are developing an ingenious system that will allow them to see plants' roots through the soil.

Scientists plant seedlings in a special pot lined with a circuit board. A small electric current passes through the soil which can create an image of the root system seeking water.

Pro GM

A natural approach?

Today, scientists all over the world are working with farmers to breed new high-yield crop varieties. Along with new practices and technologies, they are reinventing farming for the 21st century.
If scientists can sow the seeds of these new ideas around the world, farmers in developing countries will benefit.

Pro GM

A natural approach?

When plants breed, they swap genes – the sets of instructions that give them certain characteristics. Farmers have been breeding plants to create new strains with particular properties for centuries.

In genetic modification, scientists select and move genes from one plant to another in the lab. They can also choose genes from animals or bacteria to give crop particular advantages.

But is it sensible to alter plants in this way? The idea of GM food turns some people's stomachs because it can involve mixing genes that would never normally meet.

Pro GM

Feed the world

Three hundred million people in Africa rely on maize for their main source of food. But soon it could become a way to improve health too.

Eye problems are widespread in Africa, where many people don’t get enough vitamin A. Scientists are now working to cross-breed ordinary maize with a variety that contains a substance our bodies can easily convert into the missing vitamin.

Traditional plant breeding programmes like this could also result in better harvests – with no need to use GM technology at all.

Pro GM

Feed the world

A hundred million people in Africa eat the cereal sorghum every day. It’s not just their choice for breakfast, but the basis of their entire diet. The problem is its not nutritious enough for healthy growth.
Scientists want to add vitamins A and E, minerals and protein to improve sorghum. But because it is tricky to improve the plant with traditional breeding, GM is a nifty solution.
By using genetic modification, scientists can give sorghum a direct boost.
Rob says: „GM technology can give plants useful properties they couldn’t get in the wild. Why should we limit ourselves to traditional breeding methods?”

Pro GM

Let’s get growing

If you’ve travelled to America recently you’ve probably eaten GM Soya in a burger or bagel. Twenty-three countries around the world are already growing genetically modified food.

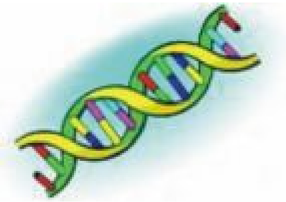
In Europe farmers have planted very few GM crops because of negative public opinion in the late 1990s.

But new generations of GM crops have the potential to produce higher yields using less land, water and pesticide. Charities – not just agrochemical giants – are interested in GM crops for the benefits they could offer the developing world.

Pro GM

Let’s get growing

Hundreds of scientists are calling for a radical change in farming around the world. Instead of turning to hi-tech genetically modified crops, they want to see approaches tailored to local conditions.
In a recent report, 400 experts concluded that, so far, GM technology hasn’t offered solutions that work for farmers in the developing world. Instead of waiting for untested GM technologies to meet farmer’s needs, they favour researching new ways of growing food to increase crop yields without damaging the environment.



Where Soya can be found?

As unprocessed bean, Soya is unpalatable for human be, because of it´s high stake of acerb substances and other substances and these substances also block the digestive enzymes. If you want to disable these substances you have to heat them. Soybeans have a high concentration of protein (30-50%) and fat (15-20%) so Soya is much in demand because at the production of comestibles and animal feed stuff it is an expensive supplier of raw-material. Elements of Soya, for example as fat, oil, emulsifier, vitamin E or herbal protein, could be in approximately 30.000 comestibles. Only in a small part of comestible goods you could find the whole bean in form of fermented products like tofu or sauce of Soya or as whole soy flour in bakery products.

Herbicide resistant Soybeans (Round-up-ready-soybean) were the first genetically modified useful plants, which were allowed to be processed in Germany. 1996 they got licensed for the processing of comestibles and animal feed stuff in Europe. They mainly come from the USA and Argentina, which belong to the biggest Soya exporter worldwide, as well as Brasil. But there is only a very occasional Soya cultivation in our latitudes, for example in Austria, because the plant needs a warm climate and much water.

Information: www.transgen.de

Material:

Flow chart of Soya processing;

3 Info cards of Soya oil, emulsifier and Soya flour;

4 Product cards with lists of ingredients

Solution:

- *Nut-Nougat-Cream:* hardened herbal oil, emulsifier: lecithin, mono- and diglycerin of aliphatic acids
- *Spice-Ketchup:* Soy extract
- *Noodle-Ready-Mix:* seasoning contained Soya protein
- *Hot-Dog-Rolls:* hardened herbal fat, emulsifier (E472e, E471)

- -

Where Soya can be found?

Since a few years genetic ally modified Soybeans could be used for the production of comestibles. They mainly come from the USA and Argentina.

Take a look at the diagram of Soya processing. The Soybeans become processed for example to Soya oil, emulsifier and Soya flour. You have to write on three cards how this Soya elements of comestible were named at the list of ingredients.

Now look at the list of ingredients with the comestible. List up every product! Which of the ingredients can be produced from Soya oil?

Where Soya can be found?

Soy oil

The soybeans consist of up to 20% oil.
But not always “soy oil” is written out this, if soy oil is inside.
In the list of ingredients it appears as vegetable oil too, partially hardened or as “plant oil”.

Emulsifier

Normally water and fat never mix. But emulsifier for example lecithin get it mixed. They cause that in the margarine the fat- and watershare don’t cut each other and develop an easy to spread baulk. Sundry emulsifier is produced from soy beans. For admixture they must be listed in the list of ingredients such as emulsifier Lecithin (E322) Emulsifier Mono- und Diglyceride (E471) Emulsifier E 472, Emulsifier E 472b, Emulsifier E 472e, Emulsifier E 475

Where Soya can be found?

Soy flour

Out of the defatted soy beans you can get soy flakes, grit and flour, compounded and processed. In the list of ingredients is written: Vegetable protein, (vegetable albumen), soy flour, soy flakes, soy grit, soy processed, soy grist.

✂----------

Converting by soybeans

Cultivation of genetically modified soya
for example in USA, Argentina

↓

Transport by sea to Europe

↓

Tofu
soy sauce
soymilk

← **Entire Beans**

↓

Oil mill

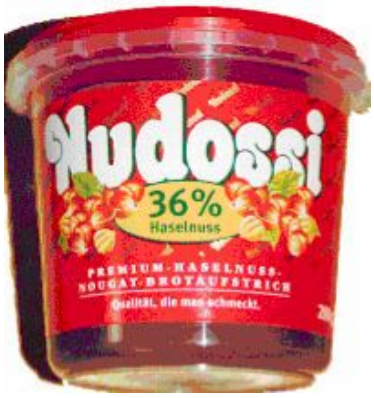
↙ ↓ ↘

Soy oil,
emulgents

Soy flour
semolina
protein concentrates
condiment

Feeding stuff

Where Soya can be found?

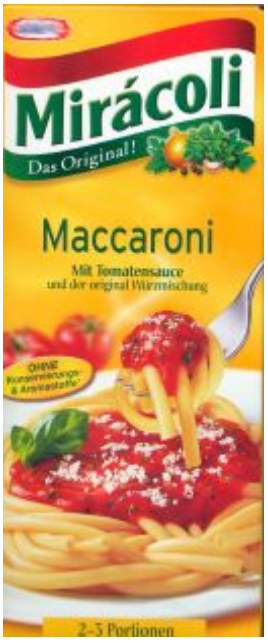


Ingredients:

**Sugar, hazelnuts,
hydrogenated plant oil,
low fat Cacao powder,
low fat milk powder,
emulsifiers: Lecithin,
Mono- and Diglyceride of
edible fat oil acids,
Salt**

Ingredients:

**Glucose syrup, water, Tomato paste
vinegar, apple, modified starch,
Curry, salt, extract of Soya,
thickening agent (Guar), herbs,
spices, herb extracts**



Ingredients:

**Durum wheat, Tomato paste,
Spices: Onions, salt, modified starch
Seasoning: (contains
Soya- and wheat protein)
Starch, sugar, herbs, garlic,
Beetroot powder, grated cheese**

Ingredients:

**wheaten flower, water, sugar,
yeast, hydrogenated plant fat,
emulsifiers (E 472e, E 471), salt**

Whose benefit?

Herbicide- or/and insect resistances are the new properties of genetically changed plants that are growing in a commercial relevant score. By way of agronomic relevant features the cultivation system should be rationalized. In this way tractor crossings for agriculture could be remains. How far actually long term an economic use for farmers amounts, lasts questionable. For example the family Monsanto extremely increased the prices for their genetic changed soybean seed, after this cultivation system was established. Furthermore – until now commercial fewer successful – mining food should be better adapted in industrial requirements by harvest, storage, transport and processing, for example by way of plants with delayed maturity. While previously only a few genes were introduced, so monogenic conditionally properties were mediated, in future should be more complex metabolism benefits changed. Made in promising is for example functionally food which is regarded with healthy reputable ingredients or plants, that should serve as detective mining. In past such different projects failed due to methodological problems without achieving market maturity.

Info: "GVO-Plants: the new generation" in www.transgen.de, "gene technology and foodstuffs", CD-ROM consumer-central NRW, 2002

Material: 3 worksheets

Proposed solution:

Herbicide – and Insect resistant plants only have advantages for agribusinesses and intensive economizing farmers. Even at the "new" plants, that could be due for marketing in foreseeable time, there is a special advantage for consumers.
So it is in question, if a rational food production through better adapted commodities could lead to lower consumer prices.
Also "healthier" fats for persons with lipid metabolism disorders probably will remain ineffective, if not at the time other important parameters of dietary behaviour, like the reduction of an excessive total fat consumption, will be considered.

✂----------

Whose benefit?

The graphic: „Genetically modified plants - worldwide crop 2002", shows the GM mediated new properties of crops, which currently are grown in a commercially relevant extent.

a)
Consider, for each of the four listed interest groups, which you can see below, whether they could have a benefit by these genetically modified plants.

1. **Agricultural companies, which can produce and market the genetically modified seed.**
2. **Farmers with intensive land use**
3. **Food manufacturers**
4. **Consumers in Europe**

b)
The figure: "Genetically modified plants – what does the future hold?" shows the main characteristics of genetically modified plants that could be introduced into the market in the next few years. Think about which of the four interest groups could have an advantage.

Whose benefit?

Agribusinesses that are producing and marketing genetically changed seed

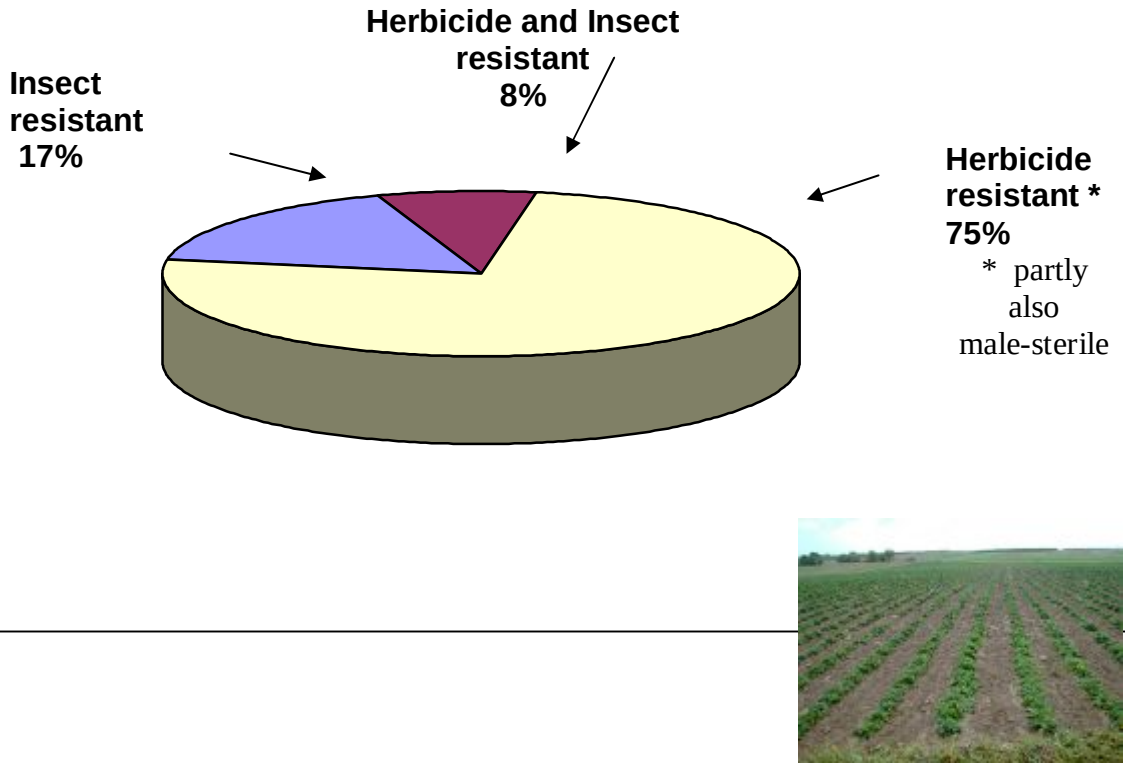
Farmers with intensive land use

Food manufacturers

Consumers in Europe

Whose benefit?

Genetically modified plants
Worldwide crop 2002



Herbicide resistance

For example, soybean, canola, maize
By using a specific agent for weed control, on the field all plants are dying.
Only the herbicide- resistant GM plants survive.
The farmer hopes for such a simplified weed management.
Seed and herbicide are matched to each other and must be bought from the same manufacturer.

- Insect resistance

For example, in maize
Constantly, the GM plants produce a poison in all plant cells.
It should kill the swill-insect, which can damage the plants.

Whose benefit?

Genetically changed plants – what does the future hold?

Herbicide resistance

for example:
sugar beet, chicory, wheat

Insect resistance

for example:
rice, sunflower

Changed fatty composition

for example:
rape (1),
soya (2)

Changed starch composition

for example:
potatoes for starch extraction (3)

Virus resistance

for example:
melons, zucchini/courgette, sugar beets (4)

(1) Rape with an increased content of Lauric-acid provides technological advantages in the margarine production.

(2) Soy oil with an increased oleic acid should be favourable for persons with a high blood fat- and blood cholesterol mirrors.

(3) A reduced share of the starch content “Amy lose” in potatoes is enabled for an efficiently starch production.

(4) The plants would be insensitive towards particular plant viruses.