

FOOD FRAUD



CONSUMER TRUST & FOOD INTEGRITY

Food fraud: consumers' opinions
and the identification
of authenticity deviations

Consumentenbond September 2016

Nelleke Polderman
Thomas Cammelbeeck
Henry Uitslag
Linda de Gouw

INDEX

Summary	4
Introduction	5
1 Research plan	7
2 Results	9
3 Conclusions	37
Literature	40
Appendix 1	42

SUMMARY

In this report, Consumentenbond (Dutch consumers' association) is presenting the results of its Consumer Trust & Food Integrity research, subsidised by the Ministry of Economic Affairs. Our team has investigated how consumers feel about food fraud, and to what extent they trust food products. Qualitative and quantitative consumer surveys have been conducted to find out. Also various authenticity tests have been performed on categories of foods that are known to be susceptible to authenticity problems.

Research confirmed that two-thirds of consumers are worried about food fraud. They expect fraud to occur most frequently in products like meat, chicken, ready meals and (shell)fish. In addition, they have relatively little faith in organic products sold in supermarkets. In recent years, these product groups have been the subject of food scandals.

According to authenticity analyses, 33 out of 156 products tested (21%) showed deviations. Relatively many were found in Manuka honey, lamb and olive oil. As far as oregano and cod are involved, deviations were found on a more limited scale.

It is not known at what stage in the supply chain the adulteration occurred and whether it was done on purpose. Therefore, it cannot be stated that a certain company has committed fraud. Nevertheless, this research confirms consumers are often misled. This is an issue of concern.

According to this research, consumers believe more effective and frequent checks combined with stricter measures should help combat food fraud. Consumentenbond argues that European and national governments and the food industry should take sufficient measures to end this problem. This will help increase consumer trust in food.

Publications based on this research (in Dutch)

- Article in Consumentengids (Consumentenbond's main magazine) October 2016
- Information on www.consumentenbond.nl/voedselontmaskerd

INTRODUCTION

Consumers are confronted with reports on food fraud on a regular basis. Probably the biggest food scandal in recent years was the one involving horsemeat. In 2013, discovering horsemeat processed in e.g. deep-frozen lasagna and 'beef' burgers caused quite a stir. Other examples of food fraud that reached the news headlines only recently, involved 'organic' eggs and cheap fish sold as a more expensive species.

These incidents have put consumer trust under pressure. The authorities and food industry have responded to this issue, also by setting up the Taskforce Food Trust.

These developments have prompted Consumentenbond to investigate how consumers feel about food fraud, and to what extent they trust their food. In addition, more than 150 products in different categories have been subjected to authenticity analyses using sophisticated methods. The project has been subsidised by the Dutch Ministry of Economic Affairs.



1 RESEARCH PLAN

1.1 Research questions

The project is based on the topics and questions below:

1.1.1 The problem:

- a What is food fraud and what is causing it?
- b How often does food fraud occur?
- c Which products are most prone to fraud?

1.1.2 Consumers' opinions:

- a To what extent do consumers trust their food?
- b According to consumers, which product groups are susceptible to fraud and which types of fraud are the most serious?
- c How do consumers feel about measures taken in order to stop food fraud and the possible consequences of additional checks performed by companies and/or the authorities (e.g. higher prices at the stores or more taxes for companies or consumers)

1.1.3 Identification:

- a Are consumers' expectations consistent with the facts?
- b How can food fraud be identified?
- c Does Consumentenbond detect food fraud?

1.1.4 Conclusions:

- a How serious is this problem?
- b How should consumers, companies and the authorities (help) solve this problem?

1.2 Research methods

1.2.1 The problem

These research questions were answered based on literary reviews.

1.2.2 Consumers' opinions

Consumers' opinions have been studied, using qualitative and quantitative consumer surveys.

The qualitative survey took place in July 2015. Two group discussions/focus groups were held (120 minutes each), with eight respondents in each group. Participants were aged 25-45 year versus > 45 years. Both groups were categorised in terms of sex, educational background and family environment. Consumentenbond cooperated with an external research agency specialising in qualitative consumer surveys.

The quantitative survey was held in March 2016. The questionnaire came with 13 questions on examples of food fraud and how consumers feel about it. The questionnaire was presented to 1059 consumers whose responses represent Dutch citizens based on age, sex and region. The respondents were recruited by an external research agency.

1.2.3 Identification

In order to answer these research questions, expert labs have been invited to perform authenticity measurements. The products chosen are susceptible to food fraud; also appropriate authenticity methods are available for these products. The following product groups have been tested:

- Cod
- Lamb
- Manuka honey
- Olive oil
- Oregano
- Various products that have exceptional ingredients (wild meat, crab meat/surimi, exotic fruits, truffle).

The selection made for each product group and the research methods applied are elaborated in Section 2.4. The authenticity analyses have been performed from mid-2015 to mid-2016.

Those providing the products under investigation were notified on the results of the analyses during a monitoring procedure in January 2016 (Manuka honey) or June-July (other products). They were given the opportunity to comment. Major companies were also invited to describe their food integrity policy.

2 RESULTS

2.1 Results of the literature reviews

What is food fraud?

Food fraud is a broad concept. It has been defined by various researchers and organisations. Common definitions are the following:

"Food is deliberately placed on the market, for financial gain, with the intention of deceiving the consumer" (Food Standards Agency, quoted in Gussow, 2014).

"The deliberate and intentional substitution, addition, tampering, or misrepresentation of food, food ingredients, or food packaging; or false or misleading statements about a product for economic gain." (Spink and Moyer 2011, p. 158)

Food fraud can be subcategorised according to the type of fraud involved. For instance, administrative food fraud means certificates are being falsified. As far as physical food fraud is involved, ingredients are exchanged for cheaper alternatives (Gussow, 2014).

Based on the above, we prepared the following definition which we used in this study:

"Food fraud involves cases in which consumers are misled on purpose because labels and names are being misrepresented. In many cases, food fraud involves ingredients that have been exchanged for inferior/cheaper alternatives. Also the origin can be misrepresented."

What is causing food fraud?

Food fraud is usually committed for economic reasons. Food fraud pays off.

Additional and related factors causing food fraud are the following (EPRS, 2014):

- The financial crisis
- Rising food prices
- Demand for cheap food
- Complex food supply chain
- Low risk of detection
- Lack of focus on detecting fraud
- Lack of a strong deterrent (penalties)

Food fraud is often considered to be an economic problem. However, human health and the environment might also be facing its negative consequences. By using toxic melamine in milk powder, in 2008 nearly 300,000 Chinese children became ill, 6 died (EPRS, 2014). Also herbs contaminated with protein from (pea) nuts can be life-threatening for those allergic to these foods. Seafood fraud means endangered species could be consumed unintentionally.

How often does food fraud occur?

Food fraud is not a new phenomenon. Affected wine and olive oil were identified already in ancient Rome. And for centuries, water has been added to milk, chalk to flour. Whether food fraud is more common today remains to be seen because now different types of fraud are involved, and also contemporary checks are different. Nevertheless, different sources confirm there have been more cases of food fraud in recent years (EPRS, 2014; Weesepeel and Van Ruth, 2015).

The British Food Standards Agency believes about 10% of all the food that we purchase in supermarkets has been adulterated. In 2010, the Food Safety and Standards Authority of India stated 13% involved adulterated food, after testing 117,000 samples (Evershed and Temple, 2016). Estimates or any reliable statistics are non-existent as far as the Netherlands is involved. Although we do know that the occurrence of authenticity problems depends heavily on the product group in question.

Which products are most prone to fraud?

Olive oil, fish and organic products are most frequently associated with food fraud (European Parliament, 2013 and Moore et al, 2012). Meat is not on this Top-10 list. Other sources, however, refer to various fraud cases involving meat (Food Fraud Network, 2014). In 2015, Rikilt published a Top-9 list with the most frequent fraud cases in the period 2008-2013, see Table 1 (Weesepeel and Van Ruth, 2015).

Table 1 Fraud cases most frequently reported in 2008-2013 involved these product groups:

1	Herbs and spices
2	Olive oil
3	Fish (products)
4	Milk (products)
5	Meat and edible offal
6	Vegetable oil (excl. olive oil)
7	Nuts and seeds
8	Honey and royal jelly
9	Other seafood

Another exploration revealed fraud cases reported in the Netherlands usually involved meat (products), fish (products), cattle feed and eggs. This is inconsistent with the worldwide pattern (Van Wagenberg et al, 2015).

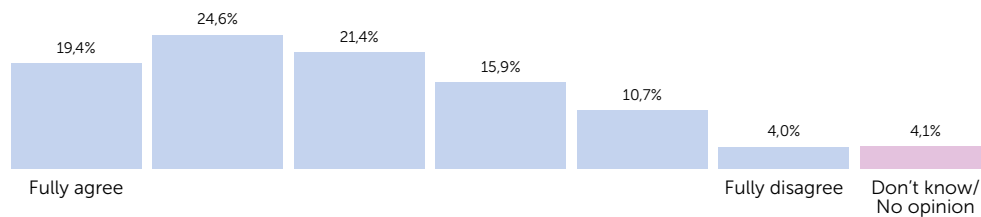
2.2 Results of consumer surveys

To what extent do consumers trust their food?

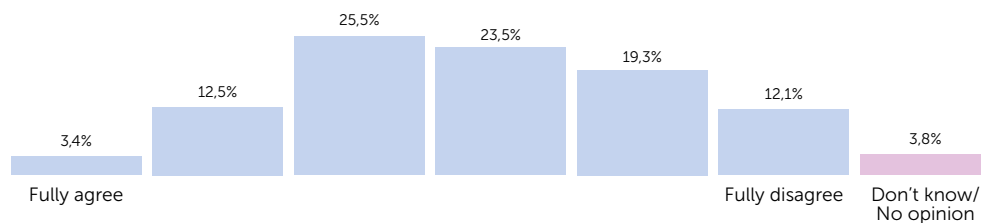
To find the answer to this question, consumers were presented with a number of statements.

Statements

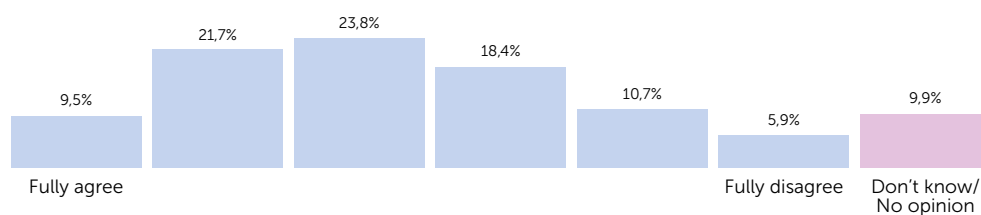
Statement: 'I worry about food fraud'



Statement: 'I trust the information on the product label is accurate'

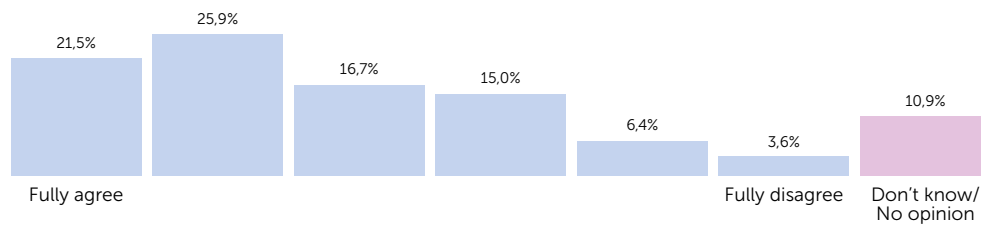


Statement: 'The cheaper the food, the more likely food fraud is'

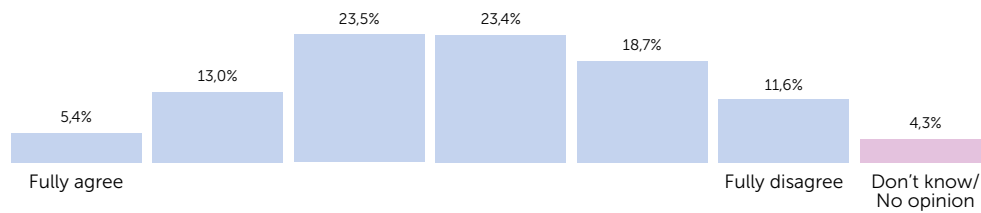


They present a mixed picture, confirming many consumers are worried about food fraud. Product labelling information cannot be taken for granted at all times; people sense food fraud is much more common nowadays. Many consumers were not quite convinced that the authorities and food industry are doing their utmost to combat food fraud.

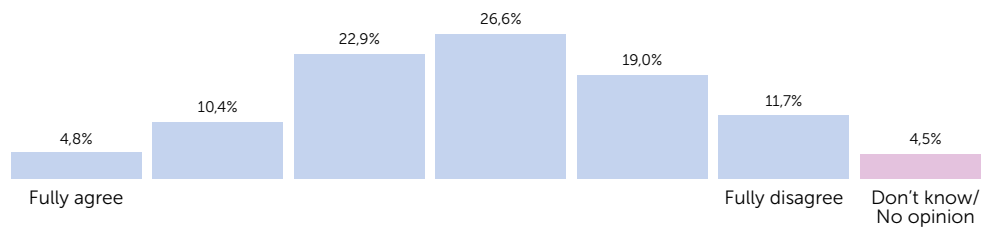
Statement: 'Today food fraud occurs more frequently than before'



Statement: 'I trust the authorities are doing whatever they can to stop food fraud'



Statement: 'I trust food industry is doing whatever it can to combat food fraud'



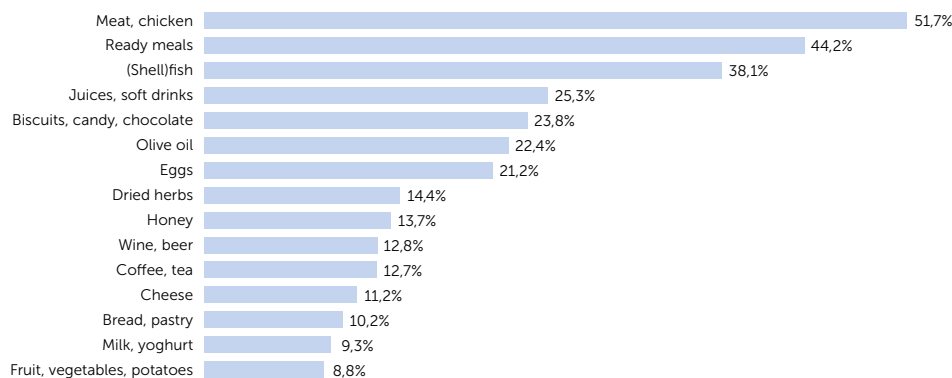
How do consumers feel about food fraud?

Respondents were asked what is the first thing that comes to their mind when they hear the words 'food fraud'. Many of them answered: "ingredients being misrepresented," "messing with food on purpose," and "selling horsemeat labelled as beef" or something similar. Others mentioned things like "misrepresenting shelf life," "adding ingredients without mentioning them" and "misrepresenting the origin."

According to consumers, which product groups are susceptible to fraud? Which types of fraud do they find the worst?

Consumers believe food fraud is most common in 'meat and chicken,' 'ready meals,' 'fish and shellfish'. They believe food fraud is least common in 'fruit, vegetables and potatoes,' 'milk and yoghurt,' 'bread and pastry' (see figure 1).

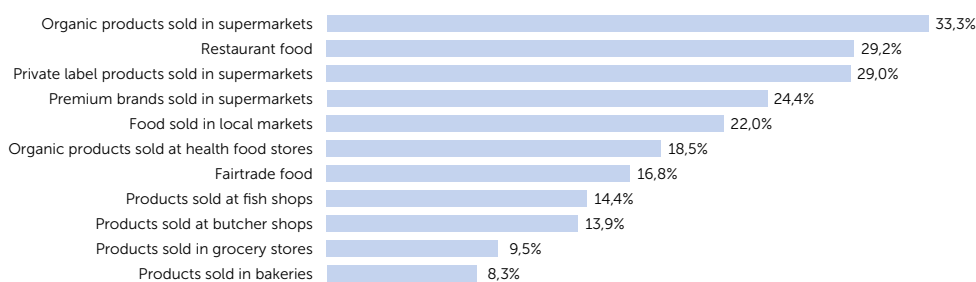
Figure 1 Fraud expectations for each product group



* Question: "How often do you believe fraud occurs in these product groups in the Netherlands?"

Consumers suspect food fraud is more common in organic food and private labels available in supermarkets compared to premium brands and products sold in local markets as well as health food stores. They believe food fraud is even less common in fresh stores like fish shops, butcher shops and bakeries. (see figure 2).

Figure 2 Fraud expectations according to supplier/ type of product



* Question: "How often do you believe food fraud occurs in the following products?"

The focus groups also confirmed consumers expect supermarkets to commit food fraud more often compared to fresh stores. Consumers believe it is because supermarkets have many suppliers, which means monitoring products is more challenging. According to consumers, fresh store owners are personally involved and they can be held responsible more easily. The focus groups also had their doubts when it comes to the authenticity of organic products sold in supermarkets. Some say it is an easy way to charge more.

Consumers were presented with a number of examples, asking whether they believe food fraud is involved, and if so, to what extent. Table 2 presents the results.

Table 2 Examples of food fraud and consumers' opinions

Examples of food fraud	Percentage of consumers who believe this is food fraud	Percentage of consumers who believe this is a (very) serious problem
Meat:		
Turkey meat being sold as lamb	95,6%	65,2%
Minced beef containing horsemeat	94,5%	67,5%
Minced lamb containing turkey meat	93,1%	53,9%
Halal meat not really halal	84,6%	34,4%
Wild boar pate containing nothing but pork	84,5%	44,3%
Crispy chicken schnitzel containing 60% of chicken meat and 40% of turkey meat	70,3%	27,4%
Fish:		
A 50% cod and 50% pangasius mixture sold as 100% cod	92,9%	54,8%
Pangasius sold as cod	92,5%	56,3%
Alaska Pollock sold as cod	90,7%	52,2%
Eggs:		
Organic eggs that are not organic	93,0%	53,5%
Barn eggs sold as free-range eggs	80,5%	41,5%
Honey:		
Manuka honey that did not come from New Zealand's Manuka tree/tea tree, but rather from less exclusive flowers	81,6%	28,7%
Honey containing added sugar	58,7%	34,4%
Other products:		
'Painted' olives to make them look fresh	88,8%	62,9%
Cheap sparkling wine labelled as Champaign	88,4%	42,9%
'Italian' olive oil produced in Spain	77,0%	23,7%
Using banned pesticides to grow fruits and vegetables	76,9%	70,5%
Oregano to which olive twigs have been added	57,2%	22,6%

* Question: Is this an example of food fraud according to you? (left-hand column) & How serious is this problem as far as you're concerned? (right-hand column)

Sometimes, food fraud is not considered as such by some consumers. Messing with meat is definitely an example of food fraud according to most of them. Fewer believe oregano to which olive twigs/leaves have been added is food fraud. The extent to which fraud is considered a (serious) problem differs. Turkey meat sold as lamb is regarded as a problem by many consumers. On the other hand, olive oil the origin of which is misrepresented is found to be less harmful. The focus groups showed consumers believe health-threatening fraud is the most severe type of fraud. It probably explains why many believe using banned pesticides is unacceptable.

How do consumers respond to food fraud?

News reports on cases of food fraud is dividing consumers into principled and habitual purchasers. The former group will intentionally avoid any affected products as well as those producing them. "The second I find out, I will definitely reconsider my purchasing behaviour," said one of them. Habitual purchasers will hold on to their purchasing patterns even though fraud has been committed. One of them commented as follows, "News on fraud will get me thinking, yes, however it won't scare me. I guess I'll never be the victim."

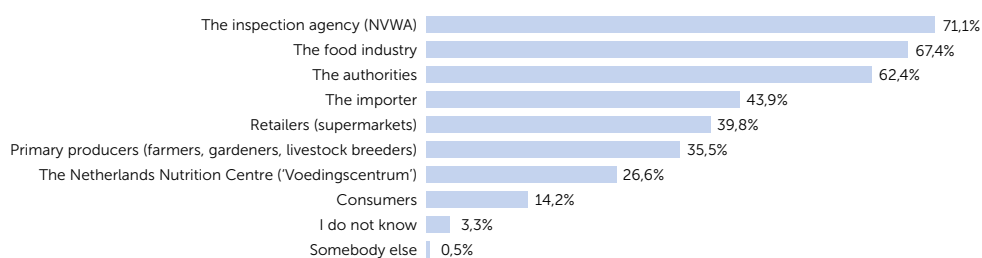
One of the differences between habitual purchasers (who will continue to buy the product) and principled buyers (who won't) presents itself in the quantitative research as well. Respondents were presented with a fictitious case of beef fraud. Initially, they had no idea which shop or product was involved. The majority of these respondents (53%) said they would change nothing and wait for more details to come out; 37% said they would not buy any beef and wait for more information. After they were told the beef in question was purchased on a regular basis in the fictitious supermarket called 'SUPERGOED', 43% said they would temporarily stop purchasing the product, however they might reconsider in the future; 29% said they would never buy the product again; 13% would continue to buy and eat the product.

What do consumers believe should happen to stop food fraud?

Consumers believe the Netherlands Food and Consumer Product Safety Authority (hereafter: NVWA) and the food industry have a key role when it comes to combatting food fraud in the Netherlands (Figure 3). They believe 'more efficient controls', 'more frequent inspections' and 'higher penalties' should help tackle this problem.

Figure 3 Responsibility for food fraud prevention according to consumers

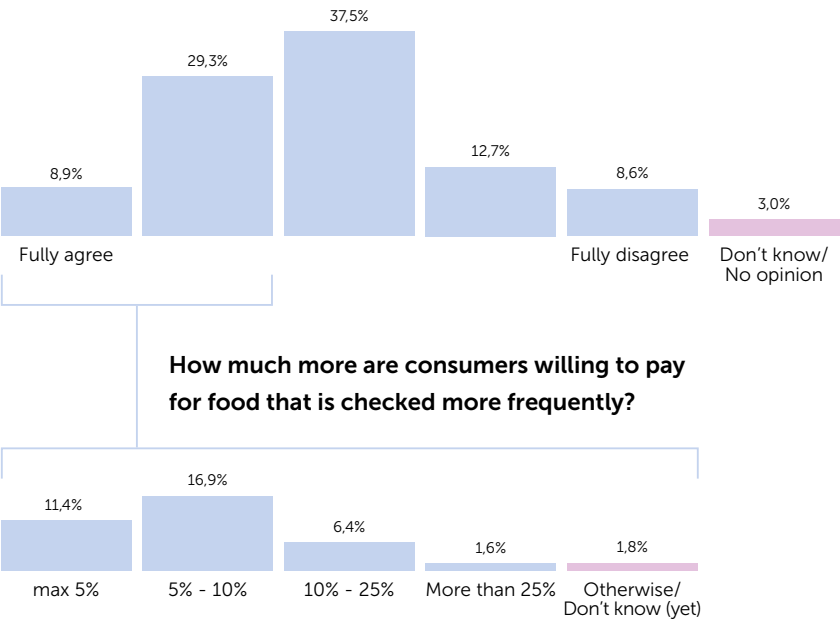
Who is responsible for preventing food fraud in the Netherlands?



Some of the consumers are willing to pay more (5 to 10% extra) for their food, provided additional food checks are carried out (figure 4).

Figure 4 Consumers’ willingness to pay more in order to combat food fraud

Statement: “I’d be happy to pay more, provided additional food checks are carried out.”



* Question: "How much more money are you willing to pay for food that is checked more frequently?"
This question was answered by 404 consumers who said they are willing to pay more.

2.4 Results of the authenticity analyses

A total of 156 products were checked for authenticity, 33 of which (21%) showed deviations. Table 3 represents the results. Relatively many deviations were found in Manuka honey, lamb and olive oil. Deviations were more limited in oregano and cod. The sections 2.4.1 up to and including 2.4.6 specify these results. Appendix 1 covers the results of all products investigated.

Table 3 Deviations

	Percentage of deviations identified	Products investigated	Deviations
Cod	3%	34	1
Lamb	47%	30	14
Manuka honey	50%	8	4
Olive oil	31%	39	12
Oregano	11%	18	2
Miscellaneous (wild, crab and surimi, exotic fruit and truffle)	0%	27	0
Total	21%	156	33

Are consumers' expectations consistent with the facts?

Consumers expect food fraud to be more common in meat, chicken and fish. These are sensitive product groups according to food fraud experts. In this research, problems with lamb have been encountered. However, hardly any problems were found as far as cod is involved.

Consumers expect fewer problems in 'milk and yoghurt', although fraud occurs in milk (products) on a regular basis. Consumers also believe fraud hardly occurs in 'dried herbs' and 'honey', and yet research confirmed fraud is often identified in these product groups.

How can food fraud be identified? Does Consumentenbond trace food fraud?

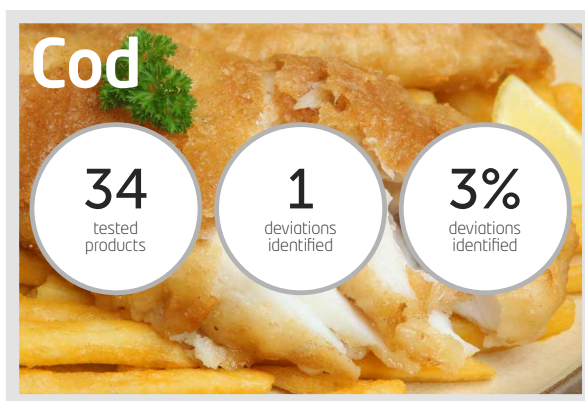
spectroscopy and isotope analyse. In addition, organisations monitoring fraud intensively use other detection methods as well, including financial verifications as well as the investigation of companies' incoming and outgoing flows.

The authenticity analyses performed within this research proved that authenticity deviations were found in some of the product groups. However, food fraud could not be proven. Based on the authenticity analyses alone, one cannot say whether actions were taken on purpose and in which part of the chain the authenticity issues presented themselves. Within the framework of this research, one cannot be certain whether these are structural or perhaps

incidental deviations. Statements can only be made for those products investigated.

2.4.1 Cod

Fraud is common in fish (products) (Weesepeel and Van Ruth, 2015). Cod is a more expensive type of whitefish which makes it sensitive to fraud. In November 2015, the environmental organisation known as Oceana reported 31.8% of 280 samples purchased in Brussels were labelled incorrectly. Most cases involved Bluefin tuna (95% inaccurate label), cod (13%) and sole (11%) (Oceana, 2015). In 2014, the British consumer organisation 'Which' purchased 45 fish samples from Fish & Chip shops in cities across the UK. In seven cases, the fish claimed was nowhere to be found. Haddock was served instead of cod; whiting instead of haddock (Which, 2014).



Selection

Deep-fried cod

- 32 'deep-fried cods' ('lekkerbekjes van kabeljauw') were purchased at fish stores located in Scheveningen and Rotterdam and the immediately surrounding places (Schiedam, Vlaardingen, Hoogvliet).
- Deep-fried cod was ordered every single time. In Rotterdam and environs, this product is usually called the 'special'.
- If the first measurement proved cod was not involved, the product was purchased and analysed once more.
- Products were purchased in February 2016, and again in March and June 2016.

Cod burgers

- Cod burgers were purchased from two different supermarket chains.
- Products were purchased in October 2015.

Methods

The fish species was determined using Next Generation DNA Sequencing.

Results

Deep-fried cod ('lekkerbek van kabeljauw')

In 31 cases, the 'lekkerbek' contained cod .

Once, hake fish was used instead. During two return visits, it turned out this company was serving hake fish even though cod was required.

Cod burgers

Both cod burgers that had been tested consisted of cod.

Companies commenting

The company supplying hake fish instead of cod (Zeevishandel Jaap den Ouden) commented as follows:

Our 'speciaaltje' and 'lekkerbek' are sold mixed together. Customers call them differently. We provide fish fillet that is widely available at that moment.

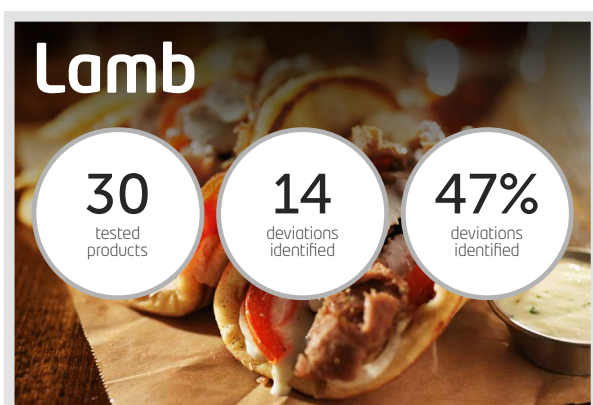
Price matters. We are doing everything we can to charge a fair price. At the time of your order, hake fish was available. In case one of our salesmen informed you cod was involved, then he should have asked to be sure.

It is not on our pricelist for sure. Whatever you purchase ('speciaaltje' or 'lekkerbek') our sales slip will say: fried fish fillet €16.50 p/kg.

Interestingly, this fish shop is selling specials and 'lekkerbek' mixed together. According to other shops in Rotterdam, these are two different products. In this particular case, Consumentenbond's purchasers requested deep-fried cod at three different moments.

2.4.2 Lamb

Meat fraud is quite common in the Netherlands (Van Wagenberg et al., 2015). Because lamb is more expensive than other meat, fraud is more likely to occur. According to research conducted by NVWA, lamb is not always 100% lamb. Six out of 57 butcher shops and small supermarkets were selling unpacked lamb which they had mixed with turkey meat (3 locations) or beef (3 locations) (NVWA, 2015). According to research conducted by a Dutch TV program known as 'Keuringsdienst van Waarde', meaning Food Inspection Service, in 2015, diced lamb sold by 10 cheap butcher shops based in The Hague did not always contain lamb, but turkey instead (3 times), or a mixture of both (once). Lamb fraud is also committed in the UK. In 2014, Consumer Organisation Which reported that 40% out of 60 take-away meals that were supposed to contain lamb contained other meat (Which, 2014).



Selection

- Three different products were chosen: lamb curry, lamb shoarma/kebab and minced lamb. (10 of each product).
- As for lamb shoarma/kebab, the restaurants addressed offered their meals on the website www.thuisbezorgd.nl (delivery to De Pijp district in Amsterdam).
- Selecting lamb curry: 10 restaurants were picked at www.thuisbezorgd.nl, filtering Oriental>Indian food and selecting the first 10 restaurants that supply lamb curry.
- Selecting lamb shoarma/kebab: At www.thuisbezorgd.nl, restaurants were analysed that delivered lamb shoarma and lamb kebab meals to the address mentioned above. A random selection was made out of 44 restaurants. Seven kebab and three shoarma meals were ordered.
- Minced meat was purchased from butcher shops in and around De Pijp district in Amsterdam.
- If the first measurement confirmed meat consisted not only of lamb, and so the product was purchased and analysed a second time. Twice it was impossible to do so because the restaurant in question no longer existed or it had discontinued its home delivery services.
- Products were purchased in February and March 2016.

Methods

The real-time PCR method was used in order to identify the following types of meat:

- Beef (*Bos taurus*)
- Pork (*Sus scrofa*)
- Mutton/lamb (*Ovis aries*)
- Goat (*Capra hircus*)
- Horsemeat (*Equus caballus*)
- Chicken (*Gallus gallus*)
- Turkey (*Meleagris gallopavo*)

The amount identified has been presented for each type of meat, using the following categories:

- major part (60-100 %)
- medium part (30-60%)
- minor part (5-30%)
- diminutive part (1-5 %)
- very diminutive part (<1%)

If less than 60-100% of the meat consisted of lamb, then this is considered a deviating result.

Results

In 14 out of 30 cases, less than 60% of lamb was involved, using beef (9 times) and turkey (5 times) instead. In 6 cases (20%), no lamb was used at all. Most deviations were found in lamb shoarma/kebab. Table 4 covers the main results.

Table 4 Lamb results

	Product contains/ consists of lamb	Product contains/ consists of lamb and other meat	Product contains/ is no lamb	Total
Lamb curry	8	0	2	10
Minced lamb	7	2	1	10
Lamb shoarma/ lamb kebab	1	6	3	10
Total	16	8	6	30

Companies commenting

Some of the restaurants and butcher shops responded to our test results.

Restaurant Kervan (kebab containing beef and lamb) commented as follows:

In January 2016, we changed our minced beef recipe. It is because pure lamb was too greasy to put on the grill, so the meat would burn. Also the smell was unpleasantly intense and customers were complaining about it. We forwarded the new recipe to our menu designer. Unfortunately, we failed to communicate properly. We will do our utmost to change the menu as early as this week, introducing our new recipe instead (minced lamb and beef).

Indeed, the description has now been changed on www.thuisbezorgd.nl. March 2016: 'highly seasoned lamb kebab'. July 2016: 'highly seasoned lamb and beef kebab'.

Restaurant Il Defino Blu (no lamb was found in sis kebab) commented as follows:

This is Thuisbezorgd's mistake. We told them months ago that these products contained beef instead of lamb. Unfortunately, they did not change the information but still, we should have checked. We change our menus on a regular basis and no mistakes had happened before. In this case we took the right information for granted. We shouldn't have.

The description has now been changed on Thuisbezorgd's website. March 2016: 'sis kebab, diced lamb skewers'. July 2016: 'sis kebab, diced tenderloin skewers'. We are not in a position to verify whether Thuisbezorgd indeed failed to meet previous change requests. However, if this is the case, then the restaurant should have mentioned the incorrect description while delivering the order.

Keurslagerij Van Vliet (no lamb in minced lamb) commented as follows:

I have extensively investigated this mistake. Some of our minced beef was labelled incorrectly, stating lamb instead. We always store large amounts of minced meat, so at the time of the second visit the labels were still incorrect. We just got ourselves new cash registers with a labelling option. We can assure you, this mistake was not on purpose. Obviously, we have solved this problem.

2.4.3 Manuka honey

Manuka is a small tree or bush from New Zealand. It is also known as tea tree. Manuka honey is produced by bees collecting nectar from the Manuka bush flowers. This honey has an antibacterial activity with methylglyoxal (MGO) being the main antibacterial ingredient (Grainger, 2015). The more MGO honey contains, the better the quality. The latter is presented in a Unique Manuka Factor (UMF), corresponding with the MGO level.

It is an expensive type of honey because of its scarcity. 'Manuka honey', however, often does not contain real Manuka honey. In the UK alone, more Manuka honey is sold than the amounts produced in New Zealand (The Grocer, 2014).



Selection

- Eight Manuka honey samples were purchased from Dutch webshops, supermarkets and health food stores.
- Seven samples claimed pure Manuka honey was involved, one sample stated 10% of Manuka honey was used; the rest consisted of floral honey.
- Products were purchased in September 2015.

Methods

The authenticity and quality of the Manuka honey was determined based on the following:

- Methylglyoxal (MGO) level, using Quantitative NMR spectroscopy
- Dihydroxyacetone (DHA) level, based on Quantitative NMR spectroscopy. DHA is the precursor of MGO.
- Hydroxymethylfurfural (HMF) level, enzymatic. The HMF level will rise in case honey has been exposed to strong or extended heating. Heating is a way to speed up the conversion of DHA into MGO, improving the quality artificially. HMF levels exceeding 40 mg/kg are not permitted by law.

Results

One of the samples, a private label brand from Jumbo did not contain Manuka honey. Two samples (Pure Gold and Melvita) contained lower MGO levels than claimed on the label. Melvita's label indirectly said 10% of Manuka honey has been used with MGO levels exceeding 83 mg/kg, however this was not the case. It either means that 10% is of an inferior quality or that less than 10% of Manuka honey had been added. The honey of a brand known as Api Health came with HMF levels beyond 40 mg/kg, which means honey had been exposed to extreme heat.

Companies commenting

Jumbo disputed the test results, claiming the absence of MGO is no conclusive evidence and also that the authenticity of honey can only be determined based on pollen analysis, however disregarding the fact that pollen can be affected as well; in which case pollen of less expensive honey are filtered, adding Manuka pollen instead.

Jumbo's honey is labelled as Manuka honey and therefore it should meet the appropriate criteria, including the existence of typical Manuka honey substances such as MGO and DHA. The absence of these substances can only mean that Manuka honey has not been used.

Jumbo confirmed the Manuka honey in question is no longer available.

De Traay, producer of the Melvita honey containing 10% of Manuka commented as follows:

We purchase Manuka honey mainly based on flavour, colour and pollen analysis. For years, we have been with the same and most reliable supplier. Authenticity is checked at independent and accredited labs. Manuka has an NPA 5+ rating; 10% of Manuka is used for blending Floral and Manuka honey.

Adding floral honey to Manuka honey makes it even more difficult to determine authenticity afterwards. By diluting no more than 10% of inferior-quality Manuka honey, the MGO levels in the final product are low to such an extent, in fact they equal the lower limit of quantification (LOQ). Nevertheless, in this case it turned out the method was sensitive enough to determine that the final product did not meet the quality claimed.

Api Health (Manuka honey exposed to extreme heat) commented as follows:

We do not perform any lab checks to determine the authenticity of 'our' Manuka honey. The brands we supply are delivered directly to us by different producers. We trust the lab reports they provide with each shipment.

2.4.4 Olive oil

Extra virgin olive oil is the most expensive olive oil and also most prone to fraud (NVWA, 2016; Mueller, 2013). Prices paid for extra virgin olive oil can vary enormously. For instance, Italian olive oil is twice as expensive as Spanish alternatives (Van Ruth, 2016). In 2016, NVWA investigated 55 samples of wholesalers, supermarkets and specialist stores. They were tested using a number of chemical parameters laid down in European Regulations. Three samples did not fully meet statutory requirements; acidity level issues were identified (twice) as well as a deviating spectrophotometric measurement (K232) (NVWA, 2016). Research conducted by the German consumer organisation Stiftung Warentest confirmed that in early 2016, the origin claimed on 5 out of 26 extra virgin olive oil labels could not be confirmed; 7 samples had negative sensory characteristics, disqualifying them for the term 'extra virgin' (Stiftung Warentest, 2016).



Selection

- The decision was made to investigate superior quality (extra virgin) olive oil.
- A selection was prepared (40 varieties) based on a market exploration in major supermarket chains, bigger discount chains and online stores. The latter were found on google (keywords: 'buy extra virgin oil'). While purchasing the oils, one product was dismissed because of poor availability. In the end, 39 variants were investigated 11 of which were ordered from online stores.
- Products were purchased in March 2016.

Methods

Category

Olive oil was investigated based on organoleptic properties according to Appendix V of the Implementation Regulation (EU) No. 1348/2013 and the International Olive Council's norms in question. Research was conducted by panels accredited by the International Olive Council.

The following categories were distinguished:

- extra virgin olive oil
- virgin olive oil
- lampante olive oil

Oil has been categorised according to the relevant directives presented in Appendix 1 of the Implementation Regulation (EU) No. 1348/2013.

If the product involved is classified as virgin or lampante, then at least two independent panels have confirmed this categorisation by identifying negative flavour characteristics that should not be found in extra virgin olive oil.

Origin

The origin of olive oil has been studied using the following method: FT-NIR (spectroscopy) & Chemometric evaluation based on the chemical (fat) composition of the olive oil.

With this method one is able to find out whether the oil's composition is resemblant of any other oil from the same country of origin. If the composition of the oil concerned and the reference oils are very different, then the origin of the oil cannot be confirmed.

Because this method is relatively uncertain at the product level, deviations are not reported for each product individually.

Results

In 12 cases (31%), olive oil could not be referred to as 'extra virgin'. In 11 cases, it was classified as 'virgin'. The flavour of one olive oil deviated to such an extent it was classified as 'lampante' oil. This Italian term means that the quality of this oil is so poor, in fact it was previously frequently used as lamp oil. Today, lampante oil is often refined and sold as olive oil for e.g. baking purposes.

In 11 cases, analyses were insufficient to confirm whether the oil's labelled origin was correct. In some cases, there was strong evidence that at least part of the product consisted of Tunisian olive oil, even though the label claimed a European origin.

Companies commenting

Aldi (selling oil classified as lampante oil) responded as follows to these results:

We tested our Mama Nature Organic Extra Virgin Olive Oil 500 ml (can) prior to its launch. The test report confirmed that based on sensory and chemical/physical analyses, this olive oil can be classified as "Extra virgin". Owing to the natural aging process, in due time each olive oil loses some of its quality because of e.g. light, temperature and interaction with air. The quality of the organic olive oil 500 ml (THT 17/8/2016) Consumentenbond has investigated deteriorated more significantly than expected. Obviously customers may count on us to maintain good quality at least until the end of the shelf life. Therefore we have decided to immediately stop selling Mama Nature Organic Olive Oil Extra Virgin 500 ml (can).

Bio+ (organic brand selling olive oil classified as virgin olive oil) commented as follows:

We considered recalling the batch you have tested, however it was last delivered four months ago, and by now we suspect it has already been consumed. Further to your results, we will re-assess those batches that are currently being supplied, to make sure that what is being sold as Bio+ extra virgin olive oil, is always extra virgin .

Deoleo (producing e.g. a Carbonell oil classified as virgin oil):

We want to emphasise the fact that while purchasing our olive oil, we check the flavour and investigate the chemical parameters at length. We do this several times during the purchasing and production process. According to these tests, the sample that you examined - Carbonell Extra Virgin with batch number L52409 – included Extra Virgin Olive Oil at the time of bottling. Olive oil is a "living" product. It means factors such as light, temperature and storage conditions might interfere with its characteristics.

Bearing in mind our Quality & Transparency commitment, as from September, we will be using green bottles for our Carbonell extra virgin products. This will help protect the olive oil more effectively from light in the logistics chain. For Bertolli, we introduced green bottles for extra virgin olive oils earlier this year.

Jumbo (a private-label product classified as virgin olive oil) responded to the test results:

Jumbo has roughly classified the purchasing process into three groups:

- *Suppliers must meet the quality and CSR terms which include supplier-specific and product-specific issues.*
- *A trained expert panel determines the sensory profiles of various olive oils AND whether they are appropriate for Jumbo's customers. In addition, these sensory characteristics are properly laid down to check whether the olive oil is delivered according to the agreements made, when the products are provided at the stores.*
- *During negotiations and while these products are provided at the stores, various microbiological and chemical samples are taken (fatty acids composition, admixture, etc.)*

Based on the products tested by our labs (chemical analyses) and expert panel, no deviations were found in the products investigated by Consumentenbond.

Superunie (responsible for Goldsun, Markant and Oké olive oil classified as virgin olive oil) and Plus (a private-label product classified as virgin olive oil) responded by submitting various test reports that are supposed to confirm the oil used is extra virgin olive oil.

We and our producers in Spain and Portugal are surprised at your test results. In this test, it is declared that the product is no extra virgin olive oil. Please find enclosed our lab results. The olive oil has been tested for various specific characteristics. In addition, the Lisbon University has conducted sensory research. Enclosed is an example of these results. All studies confirm we are providing extra virgin olive oil.

Superunie is cooperating with WUR. At the moment, prof.dr.ir. Saskia van Ruth is extensively studying olive oil. All products purchased by Superunie are included in this research and they are currently being analysed. Because even though the NVWA recently determined that olive oil in the Netherlands meets all requirements, obviously we will continue to monitor our suppliers.

Superunie ensures the integrity and authenticity of its products and working procedures is systematically being approached. This is based on a comprehensive risk analysis. Verification is based on lab analyses among other things, DNA research, 2nd party audits and traceability studies. Also Superunie is teaming up with PwC to work on the vulnerability analyses of its suppliers. To this end we are using the "Food fraud vulnerability assessment tool" developed by SSAFE, PwC and WUR.

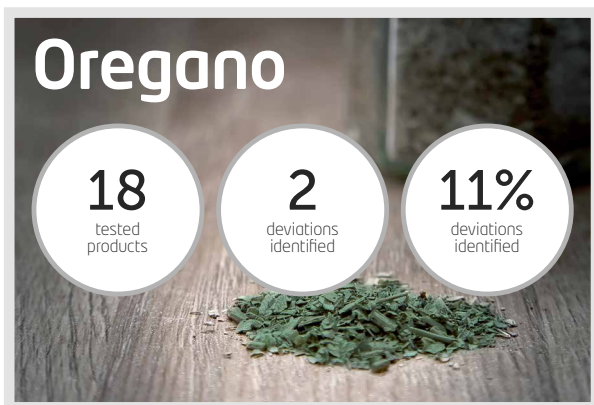
Various companies have reported that a product not classified as 'extra virgin' by at least two independent panels supposedly contained extra virgin at the time of bottling. We cannot check this. Perhaps this is true in some cases. However, extra virgin olive oil must maintain the expected quality until the end of the shelf life.

Albert Heijn (tested 4 products, no problems identified) commented as follows:

To Albert Heijn, olive oil is a high-risk product and prone to fraud. And so we have taken additional measures to ensure authenticity. Like proper supplier selection, final product analyses and (unexpected) audits. Last year, the supplier whose three products you have tested, received an unexpected visit only to find out they have been producing with integrity. Also Albert Heijn's olive oils are frequently analysed by a specialist lab to determine authenticity.

2.4.5 Oregano

Fraud is very common in herbs and spices (Weesepeol and Van Ruth, 2015). The price of one kilogram is high, which makes it sensitive to fraud. According to research performed in the UK in 2015, 13 out of 53 oregano samples (24.5%) did not contain 100% oregano. In most cases, oregano had been exchanged for olive and myrtle leaves. The amounts involved varied from approximately 30% to 70% of the total sample (Black et al., 2016; Which, 2015). Apparently, oregano fraud also very common in Australia (Choice, 2016).



Selection

- We selected 18 oregano brands, involving dried oregano sold in supermarkets, specialist stores and local markets.
- Products were purchased in August and September 2015.

Methods

Oregano authenticity was determined based on the following method:

Step 1: FT-IR (Fourier-Transform Infrared) & Chemometric modelling

Step 2: LC-HRMS

Step 2 followed provided components not being oregano were found. Step 2 is a confirmation for biomarkers from non-oregano components.

Results

Contamination with other ingredients was identified in two out of 18 samples (11%). These samples contained other ingredients for up to approximately 77% and 80%. Oregano had been exchanged for olive and myrtle leaves.

Companies commenting

Companies providing contaminated oregano failed to comment. Other companies in the herbal products industry did respond, explaining their integrity policy.

Euroma wrote as follows:

The trade association is perfectly familiar with the critical products and possible adulterations that we watch out for. Euroma specifically disclaims any form of adulteration. To make sure we supply nothing but excellent products, we have been cooperating with reliable and high-quality suppliers, seeking long-term partnerships. Also we extensively investigate the authenticity and composition of raw materials. We are aware of the problems that might present themselves as far as oregano is involved. Unfortunately, adulteration occurs on a regular basis and leads to unfair market competition. Our checks primarily involve visual and flavour checks performed by herbalists. We never found any deviations .

Verstegen too reported on the measures the company has been taking. Recently, they used the same method in order to test oregano for authenticity. They presented an analysis certificate for information purposes.

Verstegen seeks to purchase whole products as often as it can and grind them itself. It means we are better in control of the product, minimising the risk of fraud. Also fraud can be identified more easily. Ready products are tested for authenticity. For instance, paprika powder is investigated at length to find any banned colourants. Obviously, our whole raw materials are checked as well. For example, we tested oregano ourselves using the FT-IR/ chemometric modelling. We encountered no problems.

2.4.6 Miscellaneous



2.4.6.1 Game

Wild meat is consumed mainly in fall and winter. Being exclusive, it comes with a high price tag. It means fraud pays off. According to research conducted by NVWA in 2010, wild meats, particularly those processed in pates and ragout, are frequently inaccurately presented as an existing ingredient.

Selection

- Eight wild pâté brands were purchased from supermarkets, a butcher shop and a wholesaler, one wild ragout and two pieces of wild meat: jugged hare and deer succade. We investigated a total of 11 products.
- Products were purchased in December 2015.

Methods

- Qualitative animal species identification based on PCR.
- To distinguish wild boar meat (*Sus scrofa scrofa*) and pork (*Sus scrofa domestica*), we investigated the difference in pigment allele using the PCR of the Melanocortin receptor 1.

Results

In pheasant pâté, no pheasant was found. In 3 wild boar pâté samples, only pork was found. Nevertheless, this is no conclusive evidence that pheasant or wild boar meat has not been used. Perhaps the DNA levels are too low to detect. Or the DNA in question was damaged because of high pasteurisation or sterilisation temperatures, disallowing detection.

The names of the products tested have not been announced, because final conclusions cannot be drawn from this investigation.

Companies commenting

Wild boar pâté suppliers argued wild boar was definitely used. They presented analyses performed using meat rather than the final pate product. In addition, they pointed out that heating the product excludes a unequivocal conclusion about the absence of wild boar.

2.4.6.2 Products containing surimi and crab

Fraud is common in fish (products) and other seafood products (Weesepeel and Van Ruth, 2015). Surimi is imitation crab made from different fish species and water.

Selection

- This investigation involved six supermarket crab and/or surimi salads.
- In addition, two deep-frozen seafood mixes containing surimi were tested.
- Products were purchased in October 2015

Methods

Product composition was determined using Next Generation DNA Sequencing.

Results and companies' responses

In most cases, the results were consistent with the labels. In some cases, irregularities were identified.

Surimi in one seafood mix was not made from Alaska Pollock, even though this was claimed on the label. During investigation, the DNA of more than 20 fish species was found, Alaska Pollock DNA was not among them. The producer commented as follows:

The composition of this temporary surimi proved inconsistent with the regular one on which the seafood mix label is based. We are discussing the matter with our producer to prevent any future repetition.

In one crab salad, crab DNA as well as fish DNA were found. However according to the list of ingredients, this salad should not contain fish. The DNA found belongs to *Theragra chalcogramma* (Alaska Pollock) and *Lutjanus lutjanus* (Bigeye snapper). These species are often used in surimi. Based on this qualitative analysis, it is impossible to determine how much fish is used in this salad. This might be a small amount caused by e.g. cross contamination. However, some of the crabmeat might have been replaced by surimi. No fish DNA was found in the second batch of this product.

The producer provided further information on product composition, commenting as follows:

For the product that you have tested, we use nothing but real crab. Finding fish in our product came as a big surprise.

In one surimi crab salad, the DNA of the *Portunus pelagicus* crab species was not found even though the label mentioned it. Two other crab species, however, were found the label did not mention. This is no concluding evidence that the crab species in question was not used. Another batch of this salad did contain the *Portunus pelagicus* crab in addition to other crab species. The supplier commented as follows:

For both products, the agreed recipe was followed. I cannot explain these inconsistent results. However, we are certain that raw materials were used in those batches. When catching the crab species Portunus Pelagicus, cross-contamination with any bycatch cannot be excluded. As a result, other types of DNA can be found as well.

In this product, the surimi used contains <0.5% crab flavour. This crab flavour might also contain foreign DNA in addition to the species mentioned on the label.

The names of the products tested have not been announced, because final conclusions cannot be drawn from this investigation.

2.4.6.3 Exotic fruit products

Different sources confirm fraud is very common in fruit juices (Moore et al., 2012). Because of the high price tag, committing fraud with more exclusive types of fruits is interesting.

Selection

- Selection involved 4 fruit juices and 1 fruit bar containing exotic fruits like acai, goji berry and guanabana.
- Products were purchased in October 2015.

Methods

Product composition has been determined using Next Generation DNA Sequencing.

Results

The product composition identified largely corresponds to the labelled composition. All exotic fruits were found in the products. In one fruit bar and one fruit juice, no raspberry DNA was found even though the label claimed otherwise. Perhaps DNA levels were too low to detect. Or the DNA in question was damaged because of high pasteurisation or sterilisation temperatures, disallowing detection.

The names of the products tested have not been announced, because final conclusions cannot be drawn from this investigation.

Companies commenting

The companies in question pointed out that based on these results, one cannot claim raspberries were not used.

2.4.6.4 Truffle

Truffle is an expensive ingredient that can easily be replaced by cheaper truffle aroma. So it is interesting to find out whether truffle products actually contain any truffle.

Selection

- Two truffle mayonnaises and one truffle pesto were selected for this study. They contained 0.2-1.5% of truffle.
- Products were purchased in October 2015.

Methods

Product composition was determined using Next Generation DNA Sequencing.

Results

No truffle was found in any of these samples. Nevertheless, this is no conclusive evidence that truffle has not been used. Perhaps DNA levels were too low to detect. Or the DNA in question was damaged because of high pasteurisation or sterilisation temperatures, disallowing detection.

The names of the products tested have not been announced, because final conclusions cannot be drawn from this investigation.

Companies commenting

The companies in question pointed out that based on these results, one cannot claim truffle has not been used. Following this test, two companies decided to perform histological tests on the same batch. According to these histological tests, truffle was found after all.



3 CONCLUSIONS AND RECOMMENDATIONS

How serious is this problem?

Food fraud jeopardises consumer trust in food. Recent studies, including this one, demonstrate that food scandals like the horsemeat case are no exceptions. According to authenticity analyses conducted in this study, deviations were found in 33 out of 156 products (21%). This particular study involves product groups that are known to be susceptible to authenticity problems. Should other product groups have been tested, perhaps more or fewer deviations would have been identified.

Experts believe food fraud is a serious problem. They also assume only a limited amount of all cases of fraud are discovered. Consumers have every reason to be concerned. Whenever expensive ingredients are exchanged for cheaper alternatives, consumers are unnecessarily overcharged. Health risks may occur as well, for instance because the origin of products is unclear or because the product contains an undeclared allergen. In a nutshell, food fraud is causing harm beyond financial loss.

How can consumers, companies and the authorities (help) solve this problem?

There isn't much consumers can do to prevent food fraud. The American Food Protection and Defence Institute has come up with a list of protective measures consumers might want to take (Food Fraud Resources, 2016):

- Buy from reputable brands and sources
- Read the labels on the food products you buy
- Be sceptical of prices that appear too good to be true
- When possible, buy products from short, visible supply chains

But despite all this, consumers are most likely to be victims of food fraud. As research reveals, authenticity deviations occur even in expensive products sold by renowned brands and stores. And cheap products are not necessarily adulterated. When it comes to real food fraud, reading labels is not enough. So basically, consumers have limited options. And in most cases, they do not have the resources to check food authenticity.

According to this research, consumers believe more efficient and frequent checks as well as stricter measures might help combat food fraud. Consumentenbond calls for authorities and the food industry to take sufficient measures to combat this problem.

Consumentenbond previously published a list of recommendations to control food fraud more effectively (Consumentenbond, 2013):

1	Improve communication to consumers
2	Make sure NVWA is a strong and solid organisation, and immediately undo the drastic budget cuts it has been facing
3	Impose deterrent penalties
4	Reveal the offenders, blacklisting their names
5	Introduce an obligation for supermarkets and producers to check for product authenticity of the (semi-finished) products they purchase, as well an obligation for food business operators to notify to the authorities in case of (suspected) food fraud
6	Make provisions for food chains to become shorter and more transparent
7	Make country of origin labelling of all meat, poultry and fish products mandatory

Some of these measures have now been put into practice, however major improvements are required for others:

1	Consumers should have the possibility to find out which products/brands/shops experienced authenticity problems during NVWA inspections. This has not yet been implemented in government policy. Following a WOB (Government Information Act) request and after Foodwatch's court procedure, the judge ruled that in the horsemeat case, consumers were entitled to this information. Government policy should lay down that this kind of information is disclosed without delay and at all times, allowing consumers to claim compensation.	☹️
2	NVWA has been granted more capacity to investigate food fraud. However, when it comes to controlling all risks effectively, its budgets are still too tight.	😊
3	The possibilities to impose deterrent penalties have been significantly expanded after adjusting the Animals Act (Wet Dieren) and Commodities Act (Warenwet). The maximum penalty for violations of the Commodities Act has been raised from € 4,500 to € 810,000.	😊
4	No policy has been developed for taking concrete measures.	☹️

5	There are no clear requirements regarding what supermarkets and retailers should do the least to check their suppliers . Major companies are in a position to perform analyses themselves. This is less the case as far as SMEs (e.g. catering businesses, butcher stores) are involved. A collective programme allowing these companies to check their suppliers (e.g. wholesalers) might be a good solution. Also food business operators are not yet obliged to report (suspected) fraud.	☹
6	Shorter and more transparent food chains are discussed on a regular basis, however concrete steps to investigate these matters in practice and to help prevent food fraud have not yet been taken.	☹
7	European legislation concerning origin labelling has improved indeed. Nevertheless, country of origin labelling of meat as an ingredient as well as other important ingredients has not yet been taken care of.	☺

According to this research and despite the steps taken so far, many authenticity problems are still being identified, even in industries/products that are known to be susceptible to fraud. Apparently, previous measures taken by companies and the authorities are not sufficient. Companies' responses to our research reveal inconsistent corporate policies. Some say they perform fraud prevention measures, visiting suppliers unexpectedly. Others seem less involved when it comes to fraud prevention.

Authenticity testing is complex. Even though a lot is possible, methods sometimes are not specific enough for presenting conclusive evidence. Appropriate methods to identify some authenticity problems are lacking. In order to identify food fraud effectively, developing and implementing better authenticity methods is crucial.

European and national governments together with the food industry have a key role when it comes to protecting food authenticity. By guaranteeing food authenticity they can make sure that consumers can trust their food.

LITERATURE

- Consumentenbond (2013). Zeven maatregelen tegen voedsel fraude. 13 maart 2013. <http://www.consumentenbond.nl/actueel/nieuws/nieuwsoverzicht-2013/zeven-maatregelen-tegen-voedsel fraude/>
- European Parliamentary Research Service (EPRS, 2014). Fighting food fraud. Briefing 16 januari 2014. [http://www.europarl.europa.eu/RegData/bibliotheque/briefing/2014/130679/LDM_BRI\(2014\)130679_REV1_EN.pdf](http://www.europarl.europa.eu/RegData/bibliotheque/briefing/2014/130679/LDM_BRI(2014)130679_REV1_EN.pdf)
- Europees Parlement (2013). Report on the food crisis, fraud in the food chain and the control thereof. 4 december 2013. <http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+REPORT+A7-2013-0434+0+DOC+XML+V0//EN>
- Evershed en Temple (2016). Sorting the beef from the bull, the science of food fraud forensics. Bloomsbury Sigma.
- Food Fraud Network (2014). Food Fraud Network Activity Report 2014. http://ec.europa.eu/food/safety/docs/official-controls_food-fraud_network-activity-report_2014.pdf
- Food Fraud Resources (2016). How can consumers protect themselves from food fraud. <https://foodprotection.umn.edu/about/resource-library/infographics/consumer-protection-food-fraud-infographic>
- Gussow en Kuiper (2014). De bestrijding van voedsel fraude in Nederland. in: Justitiële verkenningen, Voedselcriminaliteit, mei 2014. <https://www.wodc.nl/onderzoeksdatabase/jv201402-voedselcriminaliteit.aspx?cp=44&cs=78027>
- Moore, Spink en Lipkus (2012). Development and Application of a Database of Food Ingredient Fraud and Economically Motivated Adulteration from 1980 to 2010. Journal of Food Science, 2012, Volume 77 (Number 4), p. R118-R126
- Spink en Moyer (2011). Defining the public health threat of food fraud. Journal of Food Science 76 (9). p. 157-163. <http://onlinelibrary.wiley.com/doi/10.1111/j.1750-3841.2011.02417.x/epdf>
- Spink en Moyer (2013). Understanding and combating food fraud. Food Technology magazine 67 (1). p. 30-35. <http://foodfraud.msu.edu/wp-content/uploads/2013/03/Article-Understanding-and-Combating-Food-Fraud-FT-Food-Technology-2013-01-b.pdf>
- Van Wagenberg, Benninga en Van Ruth (2015). Quick scan voedsel fraude in Nederland; Wie verzamelt welke data? Welk onderzoek is er? Wat zijn de cijfers? Wat zijn mogelijke kennislacunes? Wageningen, LEI Wageningen UR. <http://edepot.wur.nl/354464>
- Weesepeel en Van Ruth (2015). Inventarisatie van voedsel fraude: mondiaal kwetsbare productgroepen en ontwikkeling van analytische methoden in Europees onderzoek. Wageningen, RIKILT Wageningen. https://www.wageningenur.nl/upload_mm/8/b/8/600b715e-fb64-4a89-868e-e0fc0bb4072d_Rapport%202015.014_LR.pdf

Cod

- Oceana (2015). Too cheap to be true. Seafood fraud in Brussels. November 2015. http://eu.oceana.org/sites/default/files/421/oceana_factsheet_seafood_fraud_brussels_eng.pdf
- Which (2014). Which? Investigation uncovers fish fraud, fraudulent fish found in fish and chip shops. 13 september 2014. <http://www.which.co.uk/news/2014/09/which-investigation-uncovers-fish-fraud-379594/>

Lamb

- Keuringsdienst van Waarde (2015). Lamsvlees. Uitzending 16 april 2015. <http://keuringsdienstvanwaarde.kro.nl/seizoenen/2015/30-137530-16-04-2015>
- NVWA (2015). Onverpakt lamsvlees niet altijd 100% lam. 27 augustus 2015 <https://www.nvwa.nl/actueel/nieuws/nieuwsbericht/2066941/onverpakt-lamsvlees-niet-altijd-100-lam>
- Which (2014). Shocking evidence of food fraud revealed. 17 april 2014. <https://press.which.co.uk/whichpressreleases/shocking-evidence-of-food-fraud-revealed/>

Manuka honey

- Grainger (2015). DHA, MG, and manuka honey activity. The University of Waikato
- The Grocer (2014). Special investigation Manuka honey. <http://www.minervascientific.co.uk/documents/Manuka%20honey%20Grocer%20Article%202014.pdf>

Olive oil

- Mueller (2013). Extra virginity: the sublime and scandalous world of olive oil. W.W. Norton&Company.
- NVWA (2016). NVWA-onderzoek: bijna alle extra kwaliteit olijfolie voldoet aan kwaliteitseisen. Nieuwsbericht 31 mei 2016. <https://www.nvwa.nl/actueel/nieuws/nieuwsbericht/2075941/nvwa-onderzoek-bijna-alle-extra-kwaliteit-olijfolie-voldoet-aan-kwaliteitseisen>
- Stiftung Warentest (2016). Von wegen höchste Güteklasse. <https://www.test.de/Olivenoel-Jedes-zweite-im-Test-ist-mangelhaft-4971053-0/>
- Van Ruth (2016). Minder kwetsbaar voor voedsel fraude. Toepassing van SSAFE-tool in olijfolieketen. VMT 6, 10 mei 2016.

Oregano

- Black, Haughey, Chevallier, Galvin-King en Elliot (2016). A comprehensive strategy to detect the fraudulent adulteration of herbs: the oregano approach. Food Chemistry 210, 551-557.
- Choice (2016). Does your spice rack contain fake oregano? 5 april 2016. <https://www.choice.com.au/oregano>
- Which (2015). Does your spice rack contain fake oregano? 23 juli 2015. <http://www.which.co.uk/news/2015/07/does-your-spice-rack-contain-fake-oregano-408737/>

Miscellaneous

- NVWA (2010). Factsheet Speciesonderzoek wild en wildproducten 2010. https://www.nvwa.nl/txmpub/files/?p_file_id=2200681

APPENDIX 1

Cod

Shop	Address	Deviations	
Deviations identified			
Vishandel Cafetaria Jaap den Ouden	Ruigewaard 53, 3078 AV Rotterdam	3 times hake fish was detected instead of cod	
No deviations identified			
Deep-fried cod			
Andalus Fish	Markthal Unit 57, Ds J. Scharpstraat 298, 3011 GZ Rotterdam		
Bram van Diermen Vishandel	Hesseplaats 11b, 3069 EA Rotterdam		
Desmond's Vishandel	Peppelweg 180, 3053 GZ Rotterdam		
Mediterranee Zuid	Groene Hilledijk 196-198, 3074 AB Rotterdam		
Mercan's Place	Monseigneur Nolenslaan 420, 3119 EL Schiedam		
Moby Dick	Paul Krugerstraat 92, 3072 GN Rotterdam		
Gebr. Simonis	Visafslagweg 20, 2583 DM Scheveningen		
Het Haringhuisje	Vissershavenweg 66, 2583 DL Scheveningen		
Roeleveld Vis	Visafslagweg 30, 2583 DM Scheveningen		
Royal fish	Markthal Unit 61, Ds J. Scharpstraat 298, 3011 GZ Rotterdam		
Schmidt Zeevis	Mattlingeweg 333, 3044 EV Rotterdam		
Visgilde Schiedam	Hof van Spaland 65, 3121 CA Schiedam		
Visgilde Vermaas	Mia van Yperenplein 101, 3065 JK Rotterdam		
Vishandel Andaluze	1e Middellandstraat 21-B, 3014 BB Rotterdam		
Vishandel Atlantic (Nesselande)	Siciliëboulevard 702, 3059 XT Rotterdam		
Vishandel De Goeie Oude Tijd	De Loper 81, 3137 DD Vlaardingen		
Vishandel De Rog	Lorentzlaan 2, 3112KJ Schiedam		
Vishandel Hillegersberg	Freericksplaats 18a, 3054 GN Rotterdam		
Vishandel Marost	Zwaanshals 355, 3035 KL Rotterdam		
Vishandel Ooms	Marconiplein 5, 3027 HA Rotterdam		
Vishandel Ruud den Haan	Oudedijk 145, 3061 AA Rotterdam		
Vishandel Selma	Binnenhof 58a, 3068 JW, Rotterdam		
Vishandel Spaans	Westduynweg 126-124a, 2583 AC Scheveningen		
Vishandel 't Haventje	Dayer 10, 3131 CB Vlaardingen		
Vishandel 't Hoogertje	Kuiperstraat 45, 3131 CH Vlaardingen		
Visspecialist Atlantische Oceaan	Hilledijk 293A, 3074 GD Rotterdam		
Visspecialisten Kees en Chantal Sloot	Keizerswaard 12, 3078 AM Rotterdam		
Visspecialist Hoogvliet	Binnenban 79, 3191 CB Hoogvliet		
Viswinkel De Lange	Marcelisstraat 37B, 2586 RR Scheveningen		
Waasdorp Vis Lage Land	Samuel Esmeijerplein 39, 3067 AP Rotterdam		
W. den Dulk's Vishandel	Meester Arend van der Woudenslaan 43, 3076 PP Rotterdam		
Cod burgers			
Brand	Product	EAN	Best before date/batch
AH	Gebakken kabeljauwburger	8710400313809	02/10/2015
Jumbo	Kabeljauwburgers	8718499087460	02/10/2015

Lamb

Restaurant	Address	Product	Deviations identified	
			Visit February 2016	Visit March 2016
Deviations identified				
Aspendos	J P Heijestraat 170, 1054 ML Amsterdam	Adana kebab	Partly lamb, partly beef	Partly lamb, partly beef
Eethuis Sevil Ali Baba	Rozengracht 214, 1016 NL Amsterdam	Adana kebab	Partly lamb, partly beef	Partly lamb, partly beef
Genco Versmarkt	Van Woustraat 164-166, 1073LW Amsterdam	Minced lamb	Partly lamb, partly beef	Partly lamb, partly beef
HAN Ahlem Restaurant	Eerste Oosterparkstraat 251B, 1091 HA Amsterdam	Sis kebab schotel	No lamb, only beef	No second visit; order could not be placed
Il Delfino Blu	Pieter Calandlaan 228K, 1069 LA Amsterdam	Sis kebab schotel	No lamb, only beef	No lamb, only beef
Kervan Restaurant	Dapperplein 25, 1093 GP Amsterdam	Kebab	Partly lamb, partly beef	Partly lamb, partly beef
Keurslagerij T.A. van Vliet	Marie Heinekenplein 12, 1072 MH Amsterdam	Minced lamb	No lamb, only beef and pork	No lamb, only beef
Nuri Genco supermarkt	Rijnstraat 47-49, 1078 PX Amsterdam	Minced lamb	Partly lamb, partly beef	Partly lamb, partly beef
Papa's Grill	Johanna Reynvaanstraat 35, 1066 AH Amsterdam	Lamb shoarma	No lamb, only turkey	No second visit; order could not be placed
Perry's	Cornelis Troostplein 7, 1072 JJ Amsterdam	Lamb curry	No lamb, only turkey	No lamb, only turkey
Pizza Service La Capanna	Eerste Helmerstraat 251, 1054 DX Amsterdam	Lamb shoarma	Partly lamb, partly turkey	Partly lamb, partly turkey
Pizza-Meester	Osdorpplein 822, 1068 TD Amsterdam	Adana Kebab	Partly lamb, partly beef	Partly lamb, partly beef
San Siro	Pijnackerstraat 6hs, 1072 JT Amsterdam	Lamb shoarma	Partly lamb, partly turkey	Partly lamb, partly turkey
Tandoori Express	Kinkerstraat 43, 1053 DD Amsterdam	Lamb curry	No lamb, only turkey	No lamb, only turkey
No deviations identified				
Asian Eethuis	Admiraal de Ruijterweg 162hs, 1056 GW Amsterdam	Lamb curry		
Boucherie Leeuwenkamp	Ceintuurbaan 230, 1072 GE Amsterdam	Minced lamb		
Haweli Indian Food	Postjesweg 17, 1057 DT Amsterdam	Lamb curry		
Hergo	Maasstraat 53, 1078 HD Amsterdam	Minced lamb		
India Roti Room	Eerste Oosterparkstraat 67-71, 1091 GW Amsterdam	Lamb saag		
Indian Cuisine To Go	Burg. De Kievietstraat 9hs., 1111 GJ Diemen	Lamb curry		
Indian Express	Pieter Langendijkstraat 37, 1054 XX Amsterdam	Lamb bhuna		
Islamitische Slagerij Zagora	Eerste van der Helstraat 54B, 1072 NX Amsterdam	Minced lamb		
Lago Maggiore	Javastraat 91, 1094HB Amsterdam	Adana kebab		
Mother India	Ter Haarstraat 14, 1053 LJ Amsterdam	Lamb saag		
Namaste India	Van Woustraat 173, 1074 AL Amsterdam	Lamb curry		
Natraj Indian Eethuis	Transvaalstraat 5, 1092 HA Amsterdam	Lamb curry		
Noord Afrika Slagerij	Van Woustraat 186D, 1073 LZ Amsterdam	Minced lamb		
Scharrel-Slagerij Peter	Van Woustraat 136, 1073 LT Amsterdam	Minced lamb		
Slagerij Alain Bernard	Albert Cuypstraat 133, 1072 CS Amsterdam	Minced lamb		
Slagerij Woorts	Maasstraat 65, 1078 PX Amsterdam	Minced lamb		

Manuka honey

Brand	Product	Quality	Where to buy	EAN	Best before date	Batch codes	Deviations
Deviations identified							
Api Health	Manuka-Honing	UMF 15+	i.a. www.manuka-holland.nl	9421017892685	jan.-19	MH 309	Exposed to heat
Jumbo	Manuka honing	10+	Jumbo	8718449083226	6/12/17	058320/A 10:23	No Manuka
Melvita	Bloemen & Manuka honing melange (10% manuka)	NPA 5+	various supermarkets	8713406450103	7/22/17	JL6919 13:44 9316	Lower quality than claimed
Pure Gold	Manuka Honey	NPA 20+	i.a. De Tuinen	5060176679313	aug.-17	14/007	Lower quality than claimed
No deviations identified							
Kare	Manuka-Honing	UMF 15+	i.a. www.manuka-holland.nl	9421021240304	4/21/21	M1526	
Manuka Health	Manuka MGO Honing	100+	i.a. www.gezondheidsaanhuis.nl	9421023620036	1/14/19	FMH2944	
Manuka Health	Manuka MGO Honing	550+	i.a. www.gezondheidsaanhuis.nl	9421023620098	1/18/19	FMH2954	
Tahi	Manuka honing	UMF 5+	i.a. De Tuinen	9421901826079	4/8/19	50071	

Extra virgin olive oil

Brand	Product	Where to buy	EAN	Best before date	Batch codes	Deviations
Deviations identified						
Aceite Periana	Aceite verdial periana - aceite de oliva virgen extra	https://www.shopandalucia.be	8437000553403	JUL 18	20-1	virgin olive oil
Aldi Mama Nature	Biologische Olijfolie Extra Vergine (blik)	Aldi	23044890	17-08-2016	LA023-02	lampante olive oil
Bio+	Olijfolie extra vierge	various supermarkets	8718026420932	22-07-2017	L10932022	virgin olive oil
Carbonell	extra virgen / extra olijfolie van de eerste persing	various supermarkets	8410010274322	03-2017	L52409	virgin olive oil
Goldsun	Olijfolie extra vierge	i.a. Hoogvliet	8710624027865	06-2017	L43015345	virgin olive oil
Jumbo	Extra Vierge Olijfolie	Jumbo	8711715821676	14-01-2017	L - 20 A	virgin olive oil
Markant	Olijfolie extra vierge	i.a. Coop	8710458025570	3-7-2017	L-0039416 06:50	virgin olive oil
Oilio	Extra Virgin Olive Oil	i.a. Dirk	5412210004436	28-07-2017	LE6060 PROD. 29/02/2015 08:39	virgin olive oil
Oké	olijfolie extra vierge	i.a. Plus	8710624168490	07-2017	L44416005	virgin olive oil
Plus	Extra Vierge olijfolie	Plus	8710624860042	20-5-2017	L-3249238 17:52	virgin olive oil
Santagata	Olio Extra vergine di olivia Classico	Xenos	8005305200034	29-07-2016	LM0131	virgin olive oil
Tenuta Orto	Olio di oliva extra vergine	http://ilmacellaio.nl		Dez. 2016		virgin olive oil
No deviations identified						
AH	Olijfolie extra Vierge	AH	8710400101925	06-2017	LOTE H 5147 E [357/12] 19412	
AH Basic	Olijfolie extra vierge	AH	8718265810136	07-2017	LOTE H 6011 E [021/01] 03255	
AH Biologisch	Biologische olijfolie extra vierge	AH	8718906118171	07-2017	LOTE H 6011 B [026/12] 11599	
AH Excellent	Italiaanse olijfolie Extra Vierge	AH	8710400243434	12-07-2017	L12 AW 18:53	
Aldi La Villa	Extra Olijfolie van de eerste persing	Aldi	23008045	27-12-2016	LA37-031	
Art&Soul	Extra virgin olive oil	https://foodelicious.nl	5600290577425	06-2017	L1502628 Emb 031215	
Bertolli	Extra olijfolie van de eerste persing BIO	various supermarkets	8002470014848	07-2017	L6503R H2114 MI0002	
Bertolli	Olio extra vergine di olivia originale	various supermarkets	8041790200203	08-2017	L6106R H1105 M0002	
Carbonell	Selecti3n Especial / extra olijfolie van de eerste persing	various supermarkets	8410010274803	03-2017	L53409	
Casa San Carlo	Olio di oliva	http://www.lekkerumbrie.nl	-	-		
Ekoplaza	olijfolie koudgeperst extra vierge	Ekoplaza	8711521900015	07-2017	479385OB970	
Eleones Manolaki	Extra virgin olive oil	http://www.olijfolie-manolakis.nl	5206334000067	30-6-2017	LOT189	
Filippo Berio	Extra Virgin Olive Oil	various supermarkets	8002210113312	DEC 2016	LE128L 01	
Herman	Extra virgin olive oil	i.a. Action	5425600102001	11-07-2017	6012 10:23	
Iliada	Kalamata extra vierge olijfolie	various supermarkets	5201043112612	08-2017	L160118 KA 32090/2016	
Isole e Olena	Olio extra vergine di oliva	http://www.brandwijn.nl	-	31-08-2016	L.B.15	
Jumbo	Thuis uit eten Italiaanse Olijfolie Extra Vierge	Jumbo	8718449087385	24-11-2016	L-7 A	
Lidl Primadonna	Spaanse extra olijfolie van de eerste persing	Lidl	20013615	21-04-2017	5004591 L0016E	
Liquido d'Oro	Handpicked Italian olive oil	http://www.liquidodoro.com	8718754610384	30-11-2017	0115	
Marqt	Extra Vergine Olijfolie (Grieks)	Marqt	8718564180558	26-02-2017		
Monini	Classico olio extra vergine Di Oliva	various supermarkets	80053828	23-05-2017	L 23NV 21:12	
Monini	GranFruttato Extra Vierge Olijfolie	various supermarkets	8005510001525	26-05-2017	L 26NV 06:57	
Pagos de Toral	Extra virgin olive oil	http://nl.spainflavor.com	8414606485512	31-12-2017	AEA03004 03439	
Pure Olive Oil	Extra vergine	http://www.pureoliveoil.nl	5200112908798	31-12-2016	HM/NIA (^HEHE)	
Salvagno	Olio Extra Vergine Di Oliva	various organic stores	80617310	29-04-2017	L004675	
Tarragona	Extra vierge olijfolie	http://www.deolijfolieshop.nl	-	1-2017		
Valderrama	Arbequina 100% organic extra virgin olive oil	http://www.valderrama.nl	8437012887206	09-2017	L-15390	

Oregano

Brand	Product	Where to buy	EAN	Best before date	Batch codes	Deviations
Deviations identified						
Dille&Kamille	Oregano	Dille&Kamille	-	21-05-2017	037670	20% oregano, 80% olive leaves
Utrechtse Notenhandel	Oregano	Utrechtse Notenhandel	-	-	-	23% oregano, 60% olive leaves, 15% myrtle leaves
No deviations identified						
7K herbs, Biogarden Vermio	Oregano	various specialist stores	-	-	-	
AH	Biologische oregano	AH	87320459	12-07-2018	13:57 5603087	
AH	Oregano	AH	87314717	08-06-2018	04:04 5597708	
Buhara	Oregano	various supermarkets	8692888301434	12-2015	012 yk	
Euroma	Oregano	various supermarkets	8717600197208	29-06-2018		
Flying Tiger / Hedeboogard	Oregano	Flying Tiger	5704974000428	01-07-2018	P3462	
Het Blauwe Huis	Oregano Extra	various organic stores	8715487041522	01-02-2017		
Jumbo	Oregano	Jumbo	87328257	06-08-2018	5608210	
Merkloos / Bosfoor	Oregano	Bosfoor supermarkt, Wagenstraat 183, 2512 AW Den Haag	-	-	-	
Piramide	Oregano	various supermarkets	8711743521340	03-2018	808144	
Plus	Oregano	Plus	8710624952808	01-06-2017	L5153A	
Silvo	Oregano	various supermarkets	8715500060004	06-05-2018	L5127A	
Toko Goedendag	Oregano	Toko Goedendag, Vredenburg 27, 3511 BC Utrecht	8713056001397	05-20xx (illegible)	289143	
Verstegen	Biologische oregano	various supermarkets	8712200669582	30-06-2018	5532831 15:50	
Verstegen	Oregano (in plastic)	various supermarkets	8712200596703	25-03-2018	5577058 06:52	
Verstegen	Oregano gesneden (in glass)	various supermarkets	8712200947307	31-12-2018	5606945 06:51	

Enthovenplein 1
2500 BA Den Haag
Telefoon 070 445 45 45
consumentenbond.nl