

A Question of Segregation: 'GM-free' Maize Bread in Portugal

Une question de ségrégation : Le pain de maïs 'sans OGM' au Portugal

Auf die Trennung kommt es an: Portugiesisches Maisbrot ohne genetisch veränderte Inhaltsstoffe

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Coexistence starts at the farm level, but has implications for the whole supply chain. In this case study we investigate how genetically modified (GM) maize impacts the maize bread supply chain in Portugal. To this end we interviewed maize producers, traders, mills and bakers and tested maize bread samples for the presence of genetically modified organisms (GMOs).

Portugal is one of the few European countries where GM crops and non-GM crops are not only processed side-by-side but also cultivated. As such it is a prime example for the study of supply chains that deal with both varieties of crops. In this study we focus on a single product, maize bread, and the supply chain for that product where accidental mixing of GM and non-GM could occur: the maize supply chain.

Maize bread is a traditional bread in some regions of Portugal, but it is available anywhere in the country. There are no official statistics on this product, but, according to one of the largest retail groups, maize bread corresponds to 1 per cent of its bread turnover. Bread is sold through bakery retail outlets which have a 10 per cent share of the business, against 90 per cent by non-specialised retail (supermarkets), which includes in-store bakeries (Statistics of Portugal, 2013).

The traditional production of maize bread, which also includes rye and wheat flours, was based upon flint maize cultivars, with white or yellow grain, depending on the zones of the country. This type of cultivar constitutes a minor part of maize produc-

tion and consumption, where the majority is the dent yellow type.

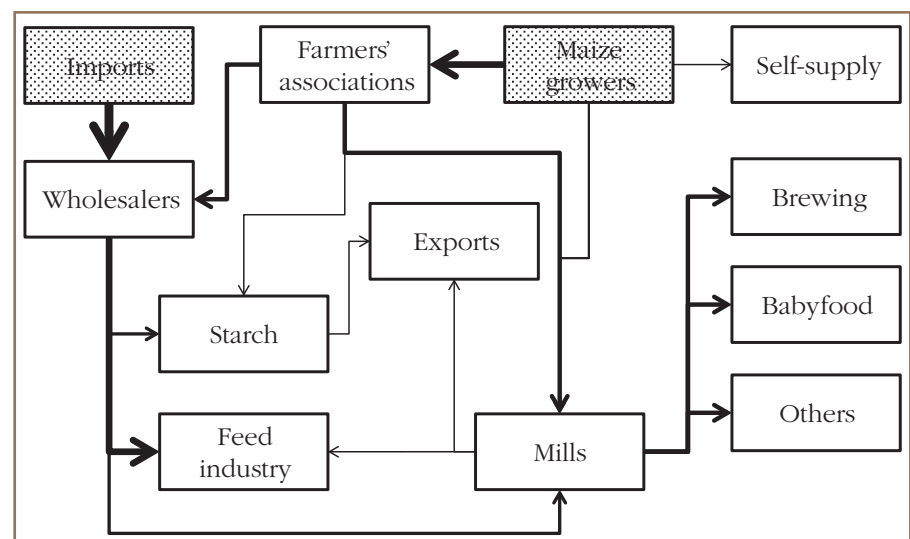
The Portuguese maize supply chain is schematised in Figure 1. Both GM and non-GM maize are produced in Portugal and imported. Within the supply chain the food and feed industry have taken clearly separate paths. The feed industry, which absorbs 94 per cent of maize, opted to label all its products as containing GMOs, called positive labelling. They buy and process both GM and non-GM maize. There is one organic feed manufacturer in Portugal; naturally it does not process GM maize, as this is not allowed when labelled organic. The major food industries – breweries, starch, breakfast cereals, baby food – demand non-GM maize, requiring either the legal threshold of 0.9 per cent (above which products must be

labelled as 'contains GMOs') or the technical zero (0.1 per cent) for the presence of GMOs. These industries have a close relationship with the primary producers of maize. Their supplies are mainly Portuguese, or sometimes from the border regions of Spain. They have stable supply circuits well routinised in keeping GM and non-GM separated to preserve identity.

The bread industry, however, is different from other food producers that process maize: scattered all over the country, atomised, with numerous actors, ranging from own production of single bakeries to industrial bakeries. In addition its final product is usually not packed and the overwhelming majority of its production is based on cereals other than maize.

For this study we interviewed maize producers, traders, mills and bakers.

Figure 1: Portuguese maize supply chain



Thickness of arrows stresses the relative importance of flows. Hatched boxes indicate potential sources of GM maize, but mixing can occur anywhere after those boxes.

We asked them about their production, identity preservation procedures, certification and audits. The study was complemented with analysis of maize bread samples for the presence of GMOs. GMO testing consisted of event-specific quantification of MON810 and NK603 using real time PCR, following the validated methods of Community Reference Laboratory for GM Food and Feed (2006 and 2005, respectively) and the positive controls were ERM-BF413f and ERM-BF415f (JRC-IRMM), respectively.

The producers of maize for maize bread

We interviewed 17 farmers who produced maize intended for maize bread. No farmer grew or was aware of neighbours growing GM-maize. Given that the Portuguese coexistence law requires written information to neighbours by farmers that intend to cultivate GM-maize, it is unlikely that any of the interviewed farmers faced accidental pollination of their maize with GM-maize ('adventitious presence').

“ Plus de 40 pour cent des maïs jaunes pains dépassaient en fait le seuil nécessitant un étiquetage et devraient être étiquetés. ”

All farmers bought hybrid seed or, in two cases, used their own seed. There was a prevalence of white over yellow maize cultivars and a large adoption of dent and semi-flint cultivars, known to be higher yielding. It should be noted that there is no GM white maize in the seed market, thus the probability of adventitious presence of GM maize in seeds of white maize is very low.

Sharing or renting of equipment or services for such things as sowing, harvesting or drying can also lead to the mechanical admixture of GM and non-GM maize. For most operations farmers did not share equipment, except during harvest; almost half of the farmers did hire or rent out harvest equipment.



Maize bread: traditional bread in Portugal.

All but one farmer sell their maize to processors; one farmer owned a mill and consequently processed the maize himself.

Only four of the 17 farmers were required to provide their customers with documentation about their maize. The required information for these four cases was respectively: 1) a seed bag label, 2) a seed bag label plus cultivation register, 3) a declaration of integrated production, and 4) a statement that the maize was non-GM. As GM-seed bags must be labelled as such, seed batch information can also demonstrate that non-GM seed was used, but it cannot prove the absence of adventitious presence. No farmer has ever been audited by a customer.

The maize traders involved in maize for maize bread

We interviewed nine traders involved in the supply chain for maize bread. They confirmed the prevalence of white maize in the maize bread supply chain. Though all traders use domestic maize, imported maize cannot be neglected. The two traders involved in imports traded with different foreign traders that import maize to Spain. The domestic maize was sourced directly from farmers; two traders also produced maize themselves.

Almost all traders focused on non-GM maize, only two traded both. Those that

trade both rely on dedicated production lines to prevent mixing. Documentation, either asked from suppliers or provided to customers (millers), is in line with what was observed among farmers: most traders do not ask for or provide documentation about the maize they are trading. One trader requires non-GM on the basis of a contract with his suppliers, and two more require documentation that non-GM seeds were used. Similarly, one trader has a contractual requirement of non-GM maize with a miller, and two more supply documentation of non-GM maize. No trader has been audited and only one of them tests for the presence of GM in supplied maize.

Mills

We interviewed 22 mills that were involved in the production of maize bread. They, too, confirmed the dominance of white over yellow maize. Mills obtain their maize from a variety of sources: own production, farmers and their cooperatives, elevators and direct imports. Among those that process maize from elevators or direct imports, 62 per cent declared that their supply includes maize from Spain, France, Ukraine, Russia, Brazil or Argentina. Two mills purchase maize directly from Spanish farmers' cooperatives. Only 23 per cent of the mills limit their supply to Portuguese farmers (including own production) or farmers' cooperatives.

Thirty-six per cent of the mills handle only non-GM maize, while 32 per cent perform segregation; the remaining 32 per cent do neither, even though only one of those mills processes only white maize, where the risk of adventitious presence is relatively low. One mill did not know the type of maize it processed.

All studied mills but one supply bakeries. The supplied bakeries are mostly small, but a few mills also supply industrial bakeries; other destinations of maize flour include retail and feed and food industry. Only one mill exports flour.

Almost one third of the mills has neither a contract nor requests documentation from their suppliers. Most (73 per cent) of those holding contracts or records stated that these provide information on GMO presence. Only one mill tested maize for the presence of GM. Testing maize flour for the presence of GM is more common: 40 per cent of the mills test their flour. Interestingly, the amount of testing does not match the demand or contractual requirements from their customers: nine mills test for GMOs in their flour, whereas only three mills need to inform their customers, contractual or otherwise, about GMO content. Auditing is more frequent at the mills; roughly 30 per cent have been audited by their customers.

Bakeries

We interviewed 40 bakeries. The bakeries use a mix of yellow and white maize flour or white maize

flour alone, but never yellow maize flour alone. Most bakeries are downstream integrated in the sense that they both produce the bread and sell it directly to the final consumer.

“ Über 40 Prozent der gelbe Maisbrot proben lagen sehr wohl über der Kennzeichnungsschwelle und sollten somit gekennzeichnet werden. ”

Only the largest bakeries (23 per cent), stated that they demand thresholds for GMO presence in maize flour, but less than half of them have suppliers' records or flour analysis that verify their demand. The demanded thresholds range from zero (actual detection limit is 0.1 per cent) to the labeling threshold of 0.9 per cent. Most bakers (83 per cent) do require general documentation about their purchases, even though these documents do not contain information on the presence of GMOs. Such discrepancy, which was not observed among the other supply chain actors, probably reflects a lack of awareness of GMO labelling regulation, in contrast with other regulations of the baking industry.

Bakeries' customers are even less demanding: there's a single bakery that, by contract, is obliged to supply non-GM bread, but no bakery has to

provide records regarding GMO content, even though customers include supermarkets of every size, which are well aware of the labelling requirements. However, according to one of the largest retail groups, suppliers are liable for the goods placed in their stores; the retail group is only liable for its own brand of goods, that is, the maize bread made in its in-store bakeries. This might account for the lack of demand for GMO information by retailers. Both the auditing of bakeries and certification of maize bread were seldom reported: 15 and 8 per cent, respectively.

Testing maize bread for GMO

The results of interviews clearly indicated that the segregation of GM and non-GM along the maize bread supply chain was imperfect; therefore one would expect to find maize bread non-compliant with EU GM-labelling regulations, particularly among yellow maize bread. We therefore collected yellow maize breads from stores in the regions where the interviews took place and had them tested for the presence of GMOs at the National Reference Laboratory of National Institute of Agrarian and Veterinary Research (*Instituto Nacional de Investigação Agrária e Veterinária*, INIAV). In 7 out of 16 samples MON810 content was above 0.9 per cent, the labelling threshold; the values ranged from 1.10 to 11.94 per cent. The only sample that exceeded 0.9 per cent of NK603 showed a very high content (41%); the only potential source was imported maize. The tests confirm that there is maize bread on the market whose GM content is above the labelling threshold without being labelled as such; this is true not only for MON810, a maize event authorised for both cultivation and import for feed and food in EU, but also for NK603, a maize event that is authorised for import into the EU but not for cultivation.

The source of this GM material remains uncertain. Although adventitious presence of GM seeds in non-GM seeds cannot be excluded, this could only account for values near the technical zero (0.1 per cent). Above threshold values due to failures at the farm level are also unlikely: besides the data from



GM maize has been grown in Portugal since 2005, where it takes up 6% of the total area of maize crop.



Imports supply 70% of the Portuguese maize needs.

maize producers reported above, non-compliances with coexistence law have seldom been reported and monitoring of non-GM maize neighbouring GM-maize crops indicates that coexistence measures keep admixtures far below the 0.9 per cent threshold (Skevas *et al.*, 2009, 2010; Quedas and Cruz de Carvalho, 2012). After what was learned from traders, mills and bakeries, failure of segregation, by blending, diverting maize from feed supply chain or deficient cleaning of shared processing lines is the most probable explanation for the high values reported above.

Segregation and coexistence required in the full supply chain

The EU requires products that contain more than 0.9 per cent of GM

ingredients to be labelled with 'contains GMOs'. To meet this requirement non-GM and GM material need to be strictly separated, and their identity needs to be preserved at all times through careful documentation.

It is important to note that it is unlikely that the failure of segregation occurred at the very beginning of the supply chain. Coexistence is manageable at the farm level (see elsewhere in this issue). If we want to take coexistence and the labelling requirements seriously, we also need to include the downstream supply chain. This requires a better control of compliance with EU labelling regulations within the maize bread supply chain by participants in the supply

chain. To achieve this, stakeholders might opt for either the implementation of sound segregation procedures or for the labelling of maize bread. We expect the latter to be easier. Currently, GM labelling is limited to edible oils in the Portuguese food market, the only food sector that deliberately releases some products derived from GM soybean. So far there is no research on Portuguese consumers' acceptance of these oils. However, the study by Aerni *et al.* (2011) suggests that negative responses by consumers are few.

“ More than 40 per cent of yellow maize breads were indeed over the labelling threshold, and should be labelled. ”

The unsteady segregation in the downstream supply chain identified by our research suggests that non-compliance with EU labelling regulations might be of interest to any EU country even if it has decided not to cultivate GM crops. After all, some of the sources in our study are clearly from imports, and the mixing has most probably taken place further down the supply chain.

Further Reading

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Summary


A Question of Segregation: 'GM-free' Maize Bread in Portugal

 We describe the maize supply chain in Portugal for maize bread, a traditional bread type. As this bread is not labelled as 'contains genetically modified organisms' it should not contain more than 0.9 per cent genetically modified ingredients. On the basis of interviews we identify a general lack of documentation of the presence or absence of genetically modified ingredients along the complete supply chain (farmers, traders, mills and bakeries). Part of this deficiency is probably driven by a lack of awareness of the labelling rules at the end of the supply chain. A test of maize bread showed that more than 40 per cent of breads were indeed over the labelling threshold, and should be labelled. This includes GM maize that is not cultivated in the EU and enters the supply chain via international trade. We conclude that the realisation of coexistence and segregation requires involvement of the full supply chain, rather than just segregation at the start, if bread is to be sold with a GMO content below the 0.9 per cent threshold level. Alternatively, retailers can label their bread. This might be a cheaper solution and as a study from Switzerland shows may not result in adverse consumer reaction.

Une question de ségrégation : Le pain de maïs 'sans OGM' au Portugal

 Nous décrivons la filière de l'offre de maïs au Portugal pour la fabrication du traditionnel 'pain de maïs'. Comme ce pain n'est pas étiqueté comme contenant des OGM, il ne devrait pas contenir plus de 0.9 pour cent d'ingrédients génétiquement modifiés. À partir d'entretiens, nous remarquons un défaut général de documentation sur la présence ou l'absence d'ingrédients génétiquement modifiés le long de la filière de l'offre complète (agriculteurs, négociants, meuneries et boulangeries). Ce défaut est probablement en partie dû à un manque de connaissance des règles d'étiquetage en fin de filière. Selon des tests faits sur le pain, plus de 40 pour cent des pains dépassaient le seuil nécessitant un étiquetage et devraient donc être étiquetés. Cela correspond à du maïs GM qui n'a pas été cultivé dans l'Union européenne et qui entre dans la filière par le biais du commerce international. Nous en concluons que la mise en place de la coexistence et de la ségrégation exige la coopération de l'ensemble de la filière et pas uniquement la ségrégation au début de la filière si le pain doit être vendu avec un taux de GMO inférieur au seuil de 0.9 pour cent. Alternativement, les détaillants peuvent étiqueter leur pain. Il pourrait s'agir une solution moins onéreuse et une étude réalisée en Suisse montre que cela pourrait ne pas entraîner de réaction négative des consommateurs.

Auf die Trennung kommt es an: Portugiesisches Maisbrot ohne genetisch veränderte Inhaltsstoffe

 Wir beschreiben die Wertschöpfungskette für Mais in Portugal für Maisbrot, eine landestypische Brotsorte. Da dieses Produkt nicht mit dem Vermerk „enthält genetisch veränderte Organismen“ gekennzeichnet ist, sollte sein Anteil an genetisch veränderten Inhaltsstoffen nicht über 0,9 Prozent liegen. Unsere Befragungen ergeben, dass es allgemein an Unterlagen fehlt, die das Vorhandensein oder Nichtvorhandensein genetisch veränderter Inhaltsstoffe entlang der gesamten Wertschöpfungskette (Landwirte, Händler, Mühlen und Bäckereien) dokumentieren. Dieser Schwachpunkt ist wahrscheinlich zum Teil auf eine fehlende Kenntnis der Kennzeichnungsvorschriften am Ende der Wertschöpfungskette zurückzuführen. Eine Untersuchung von Maisbrot ergab, dass über 40 Prozent der Proben sehr wohl über der Kennzeichnungsschwelle lagen und somit gekennzeichnet werden sollten. Dies gilt auch für genetisch veränderten Mais, der außerhalb der EU angebaut wird und über den internationalen Handel in die Wertschöpfungskette gelangt. Wir kommen zu dem Schluss, dass die Umsetzung der Koexistenz und Trennung die Beteiligung der gesamten Wertschöpfungskette erfordert und nicht nur eine Trennung zu Beginn, wenn das Brot mit einem Anteil an genetisch veränderten Inhaltsstoffen noch unterhalb des Kennzeichnungsschwellenwerts von 0,9 Prozent verkauft werden soll. Alternativ hierzu können die Einzelhändler ihr Brot kennzeichnen. Dies könnte eine kostengünstigere Lösung sein, die nicht zu einer Ablehnung durch den Verbraucher führen muss, wie Belege aus der Schweiz zeigen.

summary