This article refutes the industry claim that all GM DNA and proteins are removed during the processing of refined soybean oils made using GM techniques. It also challenges the assumption adopted by Australian food regulators that all DNA and proteins are removed during refining processes from vegetable oils, starches and sugars and, therefore, that these GM products need not be labeled as GM.

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Abstract

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Monitoring genetically modified soybean along the industrial soybean oil extraction and refining processes by polymerase chain reaction techniques

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Abstract

In the present work, the extraction and detection of DNA along a complete industrial soybean oil processing chain was described to monitor the presence of Roundup Ready® (RR) soybean. The analysed samples comprised all the steps prior to industrial oil extraction, namely, raw, cracked, laminated and expanded seeds, and the defatted flour as a sub-product. The samples collected at the refining unit included the crude oil, degummed/neutralised, washed, bleached and deodorised oil, as final product. The amplification of soybean lectin gene by end-point polymerase chain reaction (PCR) was successfully achieved in all the steps of extraction and refining processes, until the fully refined soybean oil. The amplification of RR soybean by PCR assays using event-specific primers was also achieved for all the extraction and refining steps, except for the intermediate steps of refining (neutralisation, washing and bleaching) possibly due to sample instability. The real-time PCR assays using specific probes confirmed all the

results and proved that it is possible to detect and quantify genetically modified organisms in the fully refined soybean oil. To our knowledge, this has never been reported before and represents an important accomplishment regarding the traceability of genetically modified organisms in refined oils.

Keywords: GMO detection; Soybean oil; Industrial refining; DNA extraction; Real-time PCR

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Fig. 1.

Sampling from the soybean oil production chain.

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Fig. 2.

PCR amplification targeting the soybean lectin gene of crude and degummed/neutralised oils using primers GM03/GM04. Lane 1 – crude oil; lane 2 – neutralised oil; B – blank extraction; N – negative control; M – 100 bp ladder (Bioron, Ludwigshafen, Germany).

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Fig. 3.

PCR amplification of oil samples from refining steps. A – Soybean lectin gene detection using primers LE1/LE2. B – RR soybean detection using primers RRS-3J1/RRS-3J3. Lanes 1–5 – crude, neutralised, washed, bleached and deodorised oils, respectively; B – blank extraction; P – positive control (certified reference material of 0.1% RR soybean); N – negative control; M – 100 bp ladder (Bioron, Ludwigshafen, Germany).

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Table 1. Primers and probes used in qualitative and real-time PCR. View table in article
a Genbank AJ308515.
b FAM – 6-carboxyfluorescein; BHQ2 – black hole quencher 2.

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Table 2. Concentration and purity of DNA extracts of samples from all the steps of soybean oil extraction and refining processes. View table in article
a A260 – absorbance at 260 nm; A280 – absorbance at 280 nm.

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Table 3. Real-time PCR results of samples from all the steps of soybean oil extraction and refining processes. View table in article
a Ct – cycle threshold.
b Values are the average of three replicate assays.
c CRM – certified reference material (IRMM).
d ND – not determined.
e NA – no detectable amplification.

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