

Better beer biopiracy: Indian farmers' barley patented by Japanese brewer

by Edward Hammond

The brewing company Sapporo has laid claim to a valuable barley gene developed by Indian farmers. Barley from plants with the gene can be used to brew beer that has a longer shelf life. Sapporo, based in Tokyo, has patented the gene and is working with US-based grain giant Cargill and Canada's University of Saskatchewan to develop proprietary barley varieties that contain it. The first such type, called PolarStar, is now licensed to Canadian farmers and sown under contract for Sapporo.

With ¥454.1 billion (\$5.6 billion) in 2011 annual sales, Sapporo is Japan's third largest brewer. It buys barley (*Hordeum vulgare*), the principal grain used in most beers, in Japan and imports it from other countries, including Canada. Like its domestic competitors, Asahi and Kirin, the company is interested in overseas expansion. Sapporo widely exports its namesake beer brand and, in 2006, spent \$400 million to purchase Canada's third largest brewer, Sleeman, based in Guelph, Ontario.

Barley lipooxygenase-1 (LOX-1) is an enzyme that naturally occurs in most barley grain,

but for brewers, it causes headaches. LOX-1 is one of the reasons beer develops a stale taste and weaker head (less foam) when stored for long periods.

The Indian genetic material claimed by Sapporo is a "defective" barley LOX-1 gene which does not produce LOX-1 enzyme. The company found it by screening gene bank samples for seeds with low LOX-1 enzyme levels. Since plants with the defective gene don't produce LOX-1, their grain can be used to brew beer with a longer shelf life (and possibly help in making other malted barley products).

Sapporo found the gene, which it calls "LOX-less", in Indian barley seeds held by Japan's Okayama University. The gene bank's name for the source seed is "OUI-003" (or OUI003 or SBOU2). Although it is not revealed in Sapporo's patent claims, this seed is better known as "Ballia barley", as it comes from the area near the city of Ballia in India's northern Uttar Pradesh state. Ballia is near the confluence of the Ganga (Ganges) and the Ghaghara

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(Karnali) rivers, an area of traditional barley cultivation, and part of the crop's secondary centre of diversity in the Himalayan region.

While Sapporo describes Ballia barley as a landrace, a term used by plant breeders to refer to varieties bred by farmers, sources suggest its background is a bit more complex, and lies in the efforts of both Indian farmers and public sector scientists.

According to Indian barley specialists writing in 1981, a programme to select barley varieties in Uttar Pradesh began in 1916. The programme "was confined to the development of improved varieties by selection from the indigenous material". In other words, it used local seeds from local farmers, and not barleys from elsewhere. The products of this programme included high-quality malting barleys, the type used in brewing.¹

Ballia barley was a farmers' variety selected by the programme and recommended for sowing in 1956. Sapporo's barley gene thus appears to come from a plant selection made in the mid-20th century by Indian crop scientists who were working with Uttar Pradesh farmers' varieties.

Ballia barley isn't the only barley seed that contains the LOX-less gene. Some other Himalayan farmers' varieties of barley also have it, according to Sapporo's studies. These include C.50 (OUI-001), another farmers' variety from Uttar Pradesh that was a 1950 recommendation of the same Indian programme that selected Ballia barley.²

Two other barleys also held in the Okayama University collection,³ and said to be from Nepal, were also found to have the gene. The names of these barleys, however, suggest that at least one may in fact originate in India.⁴ (The gene was also found in two Taiwanese barleys; however, it was surmised that this was a recent introduction.)⁵

The LOX-1 gene of Ballia barley was chosen by Sapporo to exemplify the type, and it is

Ballia barley seed that was selected for use in the company's breeding programme, conducted in collaboration with the University of Saskatchewan in Canada.

In scientific publications, Sapporo's scientists acknowledge the gene's Indian origin. Indeed, they rely on Indian farmers for food safety claims. According to company scientists, "The LOX-less barley lines are landrace lines cultivated in Asia, which have been used as food for a long period of time in that area. Therefore, the LOX-less barley can be safely used in brewing."⁶

Intellectual property claims

Sapporo has aggressively sought patents over the Indian gene and its use. In the last several years it has been granted a number of patents stemming from its initial international patent application (WO2004085652), filed in 2004. Patents have been granted in Europe, Australia, Canada, South Korea, the Philippines, and most recently by the United States in March 2011. Patent applications are pending in numerous other countries, including China, Russia, Mexico and South Africa.⁷

The patent claims include the sequence of the defective LOX-1 gene as found in Ballia barley as well as other defective LOX-1 genes with the same or similar mutation so as to inhibit production of barley lipoxygenase-1. The patent documents identify the origin of the gene as "a landrace", but use a company designation for the seed (SBOU2) that does not indicate its Indian origin.⁸

Under contract from Sapporo, the University of Saskatchewan has crossed Ballia barley with barley bred in Canada to produce "PolarStar", a "LOX-less" type suitable for North American commercial cultivation. PolarStar was granted a plant breeder's rights certificate (#3690) in Canada in 2009.⁹ An application for variety protection has also been filed in the United States (PVP 201200089) and is currently pending.¹⁰

Cooperation with the grain industry

Sale and grain handling of PolarStar takes place under a three-way deal involving Sapporo, the University of Saskatchewan and Cargill, the US-based grain giant. The seed is licensed to farmers exclusively for production for Sapporo, with Cargill acting as the grain handler.

After harvest, PolarStar grain goes to Prairie Malt, a Cargill-controlled company in Biggar, Saskatchewan.¹¹ Cargill malts the barley there, sending it onward to Sapporo breweries. Reportedly, PolarStar was the fourth most sown malting barley in Canada in 2010, but the companies claim further details are a trade secret.¹²

Competition with Carlsberg

Sapporo and its partners at Cargill are not the only companies moving to market with reduced-LOX barley varieties. Danish brewer Carlsberg, in collaboration with Dutch giant Heineken, has its own patented barley seeds with a defective LOX-1 gene, commercialized in several European countries as “Null-LOX” varieties.

In the United Kingdom, for example, Carlsberg-bred Null-LOX varieties including “Charmay”, “Cheerio” and “Cha Cha” are sold by Gleadell, a company jointly owned by Germany’s Toepfer International and France’s InVivo.¹³ Like with Cargill and Sapporo’s venture in Canada, the seeds are sold for contract production, and Carlsberg has obtained extensive intellectual property over them, including patents and plant breeder’s rights.

The defective LOX-1 gene contained in Carlsberg’s barleys appears to have been created using mutagenesis, rather than by crossing European varieties with Indian germplasm. (Issues related to Carlsberg’s Null-LOX barley may be considered in a future report.)

Biopiracy and benefit sharing

Barley is among the crops listed in Annex 1 of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) and is thus part of that treaty’s multilateral system of access and benefit sharing. But the Ballia accession used by Sapporo came from a Japanese gene bank, at a time when Japan was not an ITPGRFA member state.

PolarStar, the Ballia-derived barley variety, was bred under Sapporo contract by the University of Saskatchewan, a Canadian public entity. But the Treaty does not seem to require Canada to share benefits because Canada received the seed before Japan’s entry into the multilateral system. Thus while both Canada (user) and India (original source) are ITPGRFA contracting parties, and Japan (another user and intellectual property claimant) has also recently joined the ITPGRFA, no benefit sharing appears to have occurred.

This situation is not unique to the Sapporo-Saskatchewan relationship. It is frequently repeated with other seeds, particularly with germplasm from United States collections (the US is not an ITPGRFA contracting party). These large collections are typically distributed outside the multilateral system.

Another consideration is that Japan isn’t the only country to have obtained Ballia barley from India. Two barley accessions named Ballia can be found at IPK Gatersleben, the German seed bank, which has placed them into the ITPGRFA multilateral system (and from which Canada could request the seeds under the ITPGRFA Standard Material Transfer Agreement).¹⁴

Barleys named Ballia can also be found in a Polish collection as well as at the Vavilov Institute in St. Petersburg, Russia. No barley accession with the name “Ballia” can be found in the collections of CGIAR itself; however, other seeds from the same Indian programme that selected Ballia are held by CGIAR, raising the possibility that Ballia is in fact part of

the CGIAR multilateral system collection, but listed under a different name.^{15, 16}

The patented LOX-less gene was found by Sapporo researchers in three barleys other than Ballia, and these are also held in the multilateral system. For instance, the Dutch national seed bank has all three alternative sources of the gene – C.50,¹⁷ “Mazafapur Bihar”¹⁸ and “Terai Side”¹⁹ – and has placed them in the multilateral system. IPK-Gatersleben also holds “Terai Side” as part of the multilateral system.²⁰

Sapporo’s “invention” is plainly not its invention at all. In reality, it is a trait developed by Indian farmers that was selected by Indian scientists over a half-century ago. 1950s barley breeders knew enough to collect Ballia, but overlooked the significance of the Indian trait, even though similar Indian barleys were known to have superior malting characteristics. When Sapporo’s researchers came to understand the LOX-less trait’s significance, they claimed it as their own, as if it were their invention.

By patenting the LOX-less gene found in Ballia and other barleys, Sapporo scientists have committed what most would consider biopiracy. Rights to the gene and its use certainly properly lie at its origin rather than a Tokyo corporate headquarters.

In addition to Sapporo, by using Ballia and its LOX-less trait to develop other barley varieties placed under intellectual property claim, others have assumed a role in the misappropriation of the Indian resource. These include the University of Saskatchewan, which claims intellectual property rights over barley whose key selling point – absence of LOX-1 – comes from the Indian barley.

While it is clear that Sapporo has claimed as its own what properly belongs to Indian farmers, it is unfortunate that, despite decades of negotiation on seeds and access and benefit sharing, there seems to be no international arrangement available to right this wrong.

Although the LOX-less gene and first-identified sources of it are part of the ITPGRFA multilateral system, the Plant Treaty is unlikely to rectify this biopiracy because of inbuilt weaknesses – here notably permitting member states to circumvent benefit sharing by acquiring multilateral system seeds from entities outside the system.

The Ballia barley biopiracy shows the danger of such assumptions because of the ITPGRFA’s limited coverage and gaps, particularly the large collections of copies of CGIAR and other seeds of Annex 1 crops that are held outside the multilateral system and transferred without the system’s Standard Material Transfer Agreement (SMTA).

As a practical matter of patent law, India appears to have potentially strong arguments at its disposal that Sapporo hasn’t invented anything and doesn’t deserve a patent. Some of these arguments may also extend to some of the claims on similar barleys made by Carlsberg, including at least one patent granted in India itself.²¹ These arguments India might advance in order to seek nullification of Sapporo’s intellectual property.

In addition, Sapporo’s failure to identify the country of origin of the barley seed in its patent applications provides another practical example lending weight to the position of many developing countries that patent law should require the disclosure of origin of genetic resources subjected to intellectual property claims.

The case also presents the opportunity to again raise the issue of *ex situ* collections for discussion by the Convention on Biological Diversity and its Nagoya Protocol on Access and Benefit Sharing, and a specific reminder that in addition to botanical gardens, microbial repositories and other collections, there are also agricultural seed banks that are not addressed by the ITPGRFA.

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Endnotes

1. Athea SC et al. (1981). Barley Diseases in India. In Proceedings of the Barley Diseases and Associated Breeding Methodology Workshop (USAID/ICARDA/CIMMYT), Rabat, 20 April.
2. Ibid.
3. The Okayama University barley collection database may be consulted at the URL: <http://www.shigen.nig.ac.jp/barley/>
4. Two low-LOX-1 barleys are indicated as Nepali by Sapporo and Okayama. One of them (OUN345) is named “Mazafapur Bihar”, quite probably for the Indian city of Muzaffarpur in Bihar state. The other (OUN347) was collected on the same 1953 expedition, and is called “Terai Side”. This is in apparent reference to the Terai, a geographic region south of the Himalayas that includes parts of both India and Nepal. Whether they are exclusively Indian, or if one or two come from Nepal, all four sources of the LOX-less gene originate in farmers’ varieties from the same geographic region.
5. Hirota N et al. (2005). Characterization of lipoxygenase-1 null mutants in barley. *Theor Appl Genet.*, 111(8): 1580-84.
6. Iimure T et al. (2010). Development of DNA markers associated with malting and brewing qualities for malting barley breeding. 21st BMBRI Triennial Barley Improvement Meeting, Guelph (Canada), 23 June.
7. Patent information from WIPO Patentscope (<http://patentscope.wipo.int>). Patentscope’s data is incomplete and it is likely that patents have been issued and applications filed in additional jurisdictions.
8. The patent documents do not identify the seed as Ballia barley nor mention its Indian origin. They also use the name “SBOU2” instead of Okayama University’s gene bank designation of OUI-003. In scientific publications, however, Sapporo researchers have written that SBOU2 and OUI-003 are the same seed.
9. Canadian Food Inspection Agency (2012). Plant Breeders’ Rights Database, entry for CDC PolarStar. URL: <http://www.inspection.gc.ca/english/plaveg/pbrpov/cropreport/bar/app00006787e.shtml>
10. USDA (2012). ARS-GRIN Database, entry for PI 664484. URL: <http://www.ars-grin.gov/cgi-bin/npgs/acc/display.pl?1897589>
11. The Prairie Malt Biggar facility was built by the provincial government, but since 1998 has been controlled by Cargill. A minority interest (42%) is held by Viterra, a Canadian grain handler with large Australian interests that is being taken over by commodities giant Glencore. [See: Viterra (2012). Malt. URL: http://www.viterra.com/portal/wps/portal/global/global/products_services/food_ingredients/malt/; and Glencore to acquire Viterra. URL: http://www.viterra.com/portal/wps/portal/global/global/about_viterra/acquisition]
12. Hofmann D (2011). U of S crop science develops better tasting beer. *The Sheaf*, 18 May. URL: <http://thesheaf.com/2011/05/18/u-of-s-crop-science-develops-better-tasting-beer/>
13. Gleadell (2012). Null-lox Malting Barley (web page). URL: <http://www.gleadell.co.uk/products/grain/malting-barley/null-lox>

14. CGIAR (2012). Genesys Database (search of barley accessions matching the term "Ballia"). URL: <http://www.genesys-pgr.org/>
15. Ibid.
16. Many selections and other seeds related to the Uttar Pradesh-based programme were assigned designations in the form of "C.xx" or "C.xxx", with the x's replaced by numbers. Many also had a farmers' name, like Ballia barley, in addition to the C.xxx designator. The catalogues of some gene banks reflect the C.xxx designations, while others use the farmers' name. Some gene banks, like Okayama University, are inconsistent (perhaps because of a lack of data). The Ballia barley held at Okayama University is not identified with a C.xxx designation; however, it may have one, and if it could be determined, this C.xxx number would facilitate identification of Ballia barley in other gene banks, possibly including the CGIAR collection.
17. Netherlands Centre for Genetic Resources (2012). CGN GENIS database entry for CGN01198. URL: <http://www.cgn.wur.nl/applications/cgngenesis/AccessionDetails.aspx?acnumber=CGN01198>
18. Ibid. Entry for CGN01208. URL: <http://www.cgn.wur.nl/applications/cgngenesis/AccessionDetails.aspx?acnumber=CGN01208> (The Dutch collection has classified "Mazafapur Bihar" as coming from India, whereas the Japanese collection indicates it is from Nepal. See note 4.)
19. Ibid. Entry for CGN00926. URL: <http://www.cgn.wur.nl/applications/cgngenesis/AccessionDetails.aspx?acnumber=CGN00926> (The Dutch collection contains geographic data suggesting this accession may, in fact, be Nepali. See note 4.)
20. IPK-Gatersleben. GBIS/I Database entry for BCC 753. URL: http://gbis.ipk-gatersleben.de/gbis_i/
21. Indian patent 239247 assigned to Carlsberg A/S, titled "Method of producing a barley plant having a mutation in LOX-1 gene", claims a defective LOX-1 gene that Carlsberg researchers say they created by inducing mutations in the laboratory.