

## Appendix 12: Synopsis of the taxonomy and secondary metabolic products of *Aspergillus* and *Penicillium* associated with coffee production

The metabolic products of 132 isolates from the niger and ochraceus groups of the genus *Aspergillus*, expressed on YES (yeast extract sucrose) agar were examined by HPLC. Only one of the 75 niger group isolates produced OTA under the conditions employed. Most of these were *A. niger* but the producing isolate was assigned to *A. citricus*, but this species may indeed be synonymous with *A. niger*. Of the remaining 57 isolates, 35 were *A. ochraceus* and 28 of these produced OTA (80% under the conditions employed). Some of these isolates have a spore colour slightly more yellow than usual but in the absence of sclerotia they have been assigned to *A. ochraceus* rather than *A. sulphureus* on the basis of their metabolite profiles. Four ochraceus-like aspergilli from India and Brasil formed a grouping, with isolates from non-coffee sources, which we feel is a new species *A. arecae* sp. nov. They are all OTA-producers. Of 17 isolates of *A. auricomus* and *A. melleus*, both of which are reported to produce OTA in the literature, none produced the mycotoxin in our tests. One Indonesian isolate of the uncommon buff-coloured fungus *Petromyces alliaceus* (= *Aspergillus alliaceus*) of the wentii group proved to be an OTA-producer.

All of the ochraceus group isolates produce xanthomegnin and viomellein and almost all, including all isolates of *A. ochraceus* produce penicillic acid. Circumdatins are produced by all of the *A. ochraceus* isolates and by none of the isolates of other taxa and an unidentified compound referred to as NB1 is produced by all but four of this taxon and none of the other isolates. Amongst the *A. ochraceus* isolates, only the seven non-producers produced another unidentified metabolite referred to as XXO which is produced by four of the fourteen non-producing *A. melleus* isolates as well. *A. arecae* uniquely produces cycloechinulin as well as several of the typical *A. ochraceus* metabolites but the pattern is somewhat variable.

None of the isolates of *Penicillium* produced OTA under the screening conditions. This included *P. brevicompactum*, *P. citrinum*, *P. sizovae*, *P. olsonii*, *P. chrysogenum*, *Eupenicillium shearii*. Other *Aspergillus* species that were negative for OTA production

included *A. tamarii*, *A. terreus* and *A. flavus* although the *A. flavus* isolates were positive for aflatoxin.

**Table 1.** Metabolite profiles of *Aspergillus ochraceus* and *A. ochraceus*-like isolates from coffee and coffee-related sources. Analysis does not include Kenyan or Venezuelan isolates. **OTA**=ochratoxin A; **OTB**=ochratoxin B; **XMG**=xanthomegnin. **VML**=viomellein; **CDT**=circumdatins; **CYE**=cycloecninulin; **XXO** is not known; **PAC**=penicillic acid; **VXN**=viomellein; **4HM**=4-hydroxymellein; **NB1** is unknown. **N**=niche

code	species	N	origin	OTA	OTB	XMG	VM	CDT	CYE	XXO	PAC	VXN	4HM	NB1
B204i	arec	i	B	1	1	1	1	0	1	0	1	0	1	0
I176i	arec	i	I	1	1	1	1	0	1	0	0	1	1	0
I224i	arec	i	I	1	1	1	1	0	1	0	0	0	0	0
I110	arec	s	I	1	1	1	1	0	1	0	0	0	0	0
I2-D18	ochr	s	D	1	1	1	1	1	0	0	1	0	1	1
I2-A5	ochr	s	I	1	1	1	1	1	0	0	1	0	1	1
D180p	ochr	p	D	1	1	1	1	1	0	0	1	1	0	1
B1n	ochr	n	B	1	1	1	1	1	0	0	1	1	0	1
D169i	ochr	i	D	1	1	1	1	1	0	0	1	1	0	1
B4n	ochr	n	B	1	1	1	1	1	0	0	1	1	0	1
D193i	ochr	i	D	1	1	1	1	1	0	0	1	1	0	1
I66a	ochr	a	I	1	1	1	1	1	0	0	1	1	0	1
B159s	ochr	s	B	1	1	1	1	1	0	0	1	1	0	1
B205i	ochr	i	B	1	1	1	1	1	0	0	1	1	0	1
I183	ochr	s	I	1	1	1	1	1	0	0	1	1	0	1
B2x	ochr	x	B	1	1	1	1	1	0	0	1	1	0	1
B160s	ochr	s	B	1	1	1	1	1	0	0	1	1	0	1
B244a	ochr	a	B	1	1	1	1	1	0	0	1	1	0	1
I66a	ochr	a	A	1	1	1	1	1	0	0	1	1	0	1
I86	ochr	s	I	1	1	1	1	1	0	0	1	1	0	1
B235i	ochr	i	B	1	1	1	1	1	0	0	1	1	0	0
B193i	ochr	i	B	1	1	1	1	1	0	0	1	1	0	1
B207i	ochr	i	B	1	1	1	1	1	0	0	1	1	0	1
N5-3B	ochr	i	I	1	1	1	1	1	0	0	1	1	0	1
CC3-1	ochr	i	B	1	1	1	1	1	0	0	1	1	0	1
I17y	ochr	y	I	1	1	1	1	1	0	0	1	1	0	0
B189i	ochr	i	B	1	1	1	1	1	0	0	1	1	0	1
B243a	ochr	a	B	1	1	1	1	1	0	0	1	1	0	1
CC2-3	ochr	i	B	1	1	1	1	1	0	0	1	1	0	1
B273a	ochr	a	B	1	1	1	1	1	0	0	1	1	0	0
I74i	ochr	i	I	1	1	1	1	1	0	0	1	1	0	0
CC1-1	ochr	i	B	1	1	1	1	1	0	0	1	1	0	1
I2-D19	ochr	s	D	0	0	1	1	1	0	1	1	0	1	1
I2-A3	ochr	s	I	0	0	1	1	1	0	1	1	0	1	1
B467i	ochr	i	B	0	0	1	1	1	0	1	1	0	1	1
D174p	ochr	i	D	0	0	1	1	1	0	1	1	0	1	1
D175i	ochr	i	D	0	0	1	1	1	0	1	1	0	1	1
I180	ochr	s	I	0	0	1	1	1	0	1	1	0	1	1
I21i	ochr	i	I	0	0	1	1	1	0	1	1	0	0	0

B=Brasil; I=India; D=Indonesia. i=internal; a=air; s=soil; x=external (cherry); n=processing by-product; y=external (green coffee); ochr=*A.ochraceus*; arec=*A.arecae*

**Table 2.** Metabolic profiles of isolates from OTA non-producing species of the ochraceus group of the genus *Aspergillus* from coffee and coffee-related sources. **XMG**=xanthomegnin. **VML**=viomellein; **PAC**=penicillic acid; **XXO**=unknown; **MEL**=mellein; **VXN**=viomellein; **4HM**=4-hydroxymellein. N=niche

code	species	N	origin	XMG	VML	PAC	XXO	MEL	VXN	4HM
I2-D6	auri	s	D	1	1	1	0	0	0	1
I44	mell	s	I	1	1	1	0	0	0	0
I2-B10	mell	s	B	1	1	1	0	1	0	0
I2-D7	mell	s	D	1	1	1	0	1	0	0
I2-D2	mell	s	D	1	1	1	0	0	0	0
I2-B9	mell	s	B	1	1	1	0	1	0	0
I2-D1	mell	s	D	1	1	1	0	1	0	0
I2-B3	mell	s	B	1	1	1	0	0	0	0
I65a	auri	a	I	1	1	1	0	0	0	0
I195	mell	s	I	1	1	1	0	1	0	0
I39	mell	s	I	1	1	1	0	0	0	0
I221i	mell	i	I	1	1	0	1	0	1	1
I241i	mell	i	I	1	1	0	1	0	1	1
I9a	auri	a	I	1	1	0	1	0	0	0
I223i	mell	i	I	1	1	0	0	1	0	1
I109a	mell	a	I	1	0	1	1	0	0	0
I119p	mell	i	I	1	0	1	1	0	0	0

B=Brasil; I=India; D=Indonesia. i=internal; a=air; s=soil; x=external (cherry); n=processing by-product; y=external (green coffee); auri=*A.auricomus*; mell=*A.melleus*