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AI-Driven Photonic Platform for Detection and Degradation of Aflatoxins

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Purpose: Summarize the scientific foundation, product approach, market need, regulatory landscape, and commercialization plan for Pronolog's aflatoxin detection + mitigation platform.

1. Executive Summary

Aflatoxins—especially Aflatoxin B1 (AFB1)—are among the most serious food safety contaminants, impacting public health, export compliance, and commodity value. Pronolog is developing a platform that closes the loop from rapid, non-destructive detection to non-chemical photonic mitigation, supported by AI-driven analytics and audit-ready documentation.

What we build: (1) UV-A excited fluorescence + hyperspectral imaging (HSI) for on-line screening and severity mapping; (2) AI models for decisioning and traceability; (3) temperature controlled pulsed UV/UV-rich pulsed xenon photonic treatment for targeted detoxification.

Why now: Major markets enforce low aflatoxin limits, increasing the need for faster screening and mitigation at industrial scale. Current lab methods are accurate but often slow and expensive for high-throughput operations.

Commercial thesis: Start with grain/nut/spice processors and exporters, validate against reference lab methods, and scale via modular deployments (inline conveyor or batch chamber).

Note on evidence: Published peer-reviewed studies show pulsed light can significantly reduce AFB1 in both solid and liquid food matrices within seconds to minutes; Pronolog's engineering program is designed to translate these findings into safe, dose-controlled industrial equipment.

Investor highlights: A single platform that integrates (a) rapid, non-destructive screening, (b) AI-based decisioning with traceability, and (c) dose-logged photonic mitigation to reduce rejections, rework, and compliance risk.

2. Problem: health, compliance, and economics

Naturally occurring aflatoxins are classified as carcinogenic to humans (Group 1) by the International Agency for Research on Cancer (IARC). Contamination can occur pre-harvest and during storage, particularly under heat and moisture stress. FAO communications describe wide-ranging contamination estimates and emphasize mycotoxins as a One Health challenge.

Operationally, aflatoxins create three recurring pains for food value chains: (1) public health risk; (2) export rejection and regulatory penalties; (3) value loss from downgraded lots and rework.

Opportunity: A closed-loop system that can rapidly locate contamination hotspots, support accept/reject decisions, and enable safe mitigation where permissible—while generating documentation for auditors and buyers.

3. Regulatory landscape (selected highlights)

Jurisdiction	Illustrative limit / action level	Source
European Union	AFB1: 2 µg/kg; Total aflatoxins: 4 µg/kg (example: cereals and derived products)	EU Reg. (EU) 165/2010
United States (FDA)	Action level: 20 ppb total aflatoxins for many foods (policy basis and listings)	FDA action levels
India (FSSAI – reported)	Ready-to-eat & dried figs: 10 µg/kg total; cereals/pulses/nuts (for processing): 15 µg/kg; spices: 30 µg/kg; AFM1 in milk: 0.5 µg/kg	FSSAI (2020) summary

Regulatory limits vary by commodity and intended use. Pronolog's platform is designed to support screening, mitigation, and documentation aligned to the customer's target market requirements and QA workflows.

4. Technology: detection + decisioning + photonic mitigation

System intent: provide a repeatable workflow that converts optical signals into actionable contamination decisions and (where appropriate) applies photonic treatment with dose logging.

Commodity Infeed	UV-A + HSI Scan	AI Severity Map	Pulsed UV Treatment	QA Report

4.1 Detection module (UV-A fluorescence + hyperspectral imaging)

Aflatoxin B1 fluoresces under UV-A excitation. Pronolog's detection concept uses UV-A illumination (commonly around 365 nm) to excite fluorescence and hyperspectral imaging to capture spectral signatures across the field of view. AI models translate spectral signatures into contamination probability/severity maps, enabling automated screening and hotspot localization.

Key design goals: illumination uniformity, robust calibration, commodity-specific models, and a severity score that supports operational decisions (accept/reject, segregation, or targeted treatment).

4.2 Mitigation module (UV-rich pulsed photonics)

AFB1 degradation requires sufficient photon energy to disrupt molecular bonds. Shorter UV wavelengths (UV-C) carry higher photon energy, enabling photolysis and oxidation pathways that can inactivate toxins. Temperature controlled pulsed UV/Pulsed xenon systems can deliver high peak power, and their UV-rich spectrum can accelerate degradation compared with continuous exposure (subject to dose, matrix, and process conditions).

Example xenon flash lamp system (illustrative).

5. Evidence base (peer-reviewed examples)

Pronolog's engineering choices are grounded in published pulsed light studies demonstrating rapid AFB1 reduction in multiple matrices. These studies inform dose-controlled requirements and expected time scales, but industrial performance must be validated per commodity, thickness, moisture, and optical properties.

Matrix	Published outcome (selected)	Reference
Rough rice	80 s pulsed light reported ~75% AFB1 reduction.	Wang 2016
Rice bran	15 s pulsed light reported ~90.3% AFB1 reduction; review notes reduced genotoxicity after treatment.	Wang 2016; Kutasi 2021
Apple juice	40 flashes reported ~72.09% AFB1 degradation.	Qi 2023

Important: Any mitigation technology must be validated for product quality impacts (sensory, nutritional), safety, and regulatory acceptance for the intended commodity and market.

6. Market opportunity and commercialization plan

Industry analysts estimate the global food safety testing market at roughly USD 26B+ (mid-2020s) with continued growth driven by regulation and global trade. Pronolog targets a subset of this market focused on high-volume commodities where aflatoxin risk is recurrent and compliance requirements are strict.

Primary customer segments: Global grain processors, nut processors, spice processors, exporters/aggregators, water purifiers, other consumable liquids and large storage/warehousing operations, regulators, captive food exports, trade associations, compliance bodies, SME segments, packaged Food MNC's/corporates/SME's

6.1 Business model

- Hardware sale or lease (inline scan module and/or batch treatment chamber)
- Annual software subscription (AI scoring, reporting, traceability)
- Service revenue (calibration, maintenance, deployments, pilot studies)
- Turnkey project consultancy
- Turnkey project Exports
- Training programmes on AI and Food Safety in collaboration with University/Reputed Institutes
- Captive Aflatoxin tested Agriculture/Food Exports
- Testing and Certification
- Testing, training and validation services at farm/mandi level
- Establishing overseas offices enabling above business models

6.2 Competitive landscape (high level)

Existing options include laboratory chromatography (HPLC/LC-MS), immunoassays (ELISA), rapid test strips, and various optical screening approaches. Pronolog differentiates by integrating on-line screening with photonic mitigation and an audit-ready decision trail in one platform.

6.3 Value creation and indicative valuation narrative (investor view)

SFIS seed funding, when converted into a validated pilot system, creates two categories of enterprise value: (1) measurable net tangible assets (prototype equipment and test infrastructure) and (2) scalable intangible assets (IP, datasets, models, and validated SOPs) that typically drive venture valuation. The numbers below are indicative ranges for narrative purposes and should be validated with actual bills of materials, depreciation policy, and third-party validation outcomes.

Value driver	What it includes (examples)	Indicative post-pilot range (INR)
Net tangible assets	Pilot prototype equipment (optics, illumination, HSI camera, enclosure, pulsed xenon module), safety interlocks, test fixtures, calibration tools	₹10–₹35 lakh (depends on build scope and procurement)
Validated pilot dataset + models	Curated samples, lab-verified ground truth, trained commodity-specific AI models, drift/monitoring baselines	Not typically capitalized; often a primary valuation driver once validation KPIs are demonstrated
IP and documentation pack	Patent filings, design files, validation reports, QA SOPs, audit-ready reporting templates	Not typically capitalized; supports premium valuation and licensing readiness

Investor note: At seed stage, investors usually value Pronolog more on validation quality (lab correlation, pilot KPIs, repeatability, safety/regulatory acceptance) than the book value of equipment. A strong pilot can materially improve valuation even if tangible assets remain modest.

7. Roadmap and DPIIT/SFIS readiness

Pronolog's roadmap focuses on translating validated photonic mechanisms into safe industrial equipment and obtaining credible third-party validation against reference methods.

Phase	0–3 months	3–6 months	6–12 months	12–18 months
Engineering	Prototype integration	Pilot-ready + safety	Industrial pilot iterations	Manufacturing readiness
Data/AI	Dataset plan + baseline models	Commodity-specific models	Robustness + drift monitoring	Scaled deployments
Validation	Reference method partner selection	Side-by-side testing	Pilot KPIs + documentation pack	Customer acceptance + QA SOPs
IP	Already in prosecution stage	Freedom-to-operate review	Conversion/continuations	Portfolio expansion

7.1 Suggested DPIIT/SFIS use of funds

- Product engineering and safety certifications (enclosure/interlocks, UV safety, EMC as applicable)
- Dataset collection and model validation against accredited reference labs
- Pilot deployments with processors/exporters and QA workflow integration
- documentation, and commercialization readiness

DPIIT alignment statement (non-claim): The project supports India's priorities around food safety, export competitiveness, and deep-tech manufacturing by developing an indigenous AI + photonics inspection platform.

8. Key risks and mitigations

Risk	Mitigation
Matrix dependence	Dose efficacy varies by commodity, thickness, moisture, and optical properties. Mitigation: commodity-specific validation, conservative dosing, and closed-loop verification.
Quality impacts	Photonic treatments can affect sensory/nutritional attributes if over-applied. Mitigation: targeted treatment, dose caps, and quality testing in pilots.
Regulatory acceptance	Treatment acceptance may depend on jurisdiction and commodity. Mitigation: consult regulatory experts and document process controls.
Model drift	AI performance can drift with seasonal variation and new suppliers. Mitigation: calibration routines, periodic re-training, and monitoring dashboards.

References

#	Reference	URL
1	IARC (2002) – Naturally occurring aflatoxins classified as carcinogenic to humans (Group 1).	https://www.inchem.org/documents/iarc/vol82/82-04.html
2	FAO (2025) – Mycotoxin contamination estimates and One Health framing.	https://www.fao.org/naraeast/news/details/strengthening-plant-protection-to-reduce-mycotoxins-one-health-imperative/en
3	EU (2010) – Commission Regulation (EU) No 165/2010: maximum levels for aflatoxins in foods.	https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ%3AL%3A2010%3A050%3A0008%3A0012%3AEN%3APDF
4	FDA (2019) – Action levels for aflatoxins (background and policy).	https://www.fda.gov/media/121202/download
5	FSSAI (2020) – Reported Indian limits for mycotoxins (news summary).	https://fssai.gov.in/upload/media/FSSAI_news_Manual_FNB_22_12_2020.pdf
6	Wang et al. (2016) – Pulsed light degradation/detoxification of AFB1/AFB2 in rough rice & rice bran (Food Control).	https://www.sciencedirect.com/science/article/abs/pii/S0956713515300591
7	Kutasi et al. (2021) – Review of aflatoxin inactivation approaches (includes pulsed light results).	https://pmc.ncbi.nlm.nih.gov/articles/PMC8704553/
8	Qi et al. (2023) – Pulsed light degradation of	https://www.sciencedirect.com/science/article/abs/pii/S0956713523000488

	aflatoxins in apple juice (Food Control).	
9	Fortune Business Insights (accessed 2026) – Food safety testing market sizing estimates (industry analyst).	https://www.fortunebusinessinsights.com/food-safety-testing-market-108286

This document is for informational purposes and does not constitute an offer to sell securities. All forward-looking statements and target KPIs must be validated through pilots and third-party testing.

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