

WHEAT VARIETIES RELEASED

- Four wheat varieties MACS 9(d), MACS 1967(d) and MACS 4028(d) - released for **Rainfed conditions** in Peninsular Zone and MACS 6145 for North Eastern Plain Zone.
- Eight wheat varieties MACS 2496, MACS 2694(d), MACS 2846(d), MACS 3125(d), MACS 2971(dic.), MACS 6222, MACS 6478 & MACS 3949(d) Released for **Irrigated Timely sown conditions** in Peninsular Zone.
- One wheat variety MACS 4058(d) released for timely sown **restricted irrigation condition** of Peninsular zone.

MACS 2971 (*T. dicoccum*)

- Released in August 2009 for HF:TS of PZ
- Average yield 45 - 50 q/ha.
- Better quality traits with quality fibre & low glycemic index
- Therapeutic food for diabetic patients
- Used for kheer, lapshi, upma, dalia & puranpoli



MACS 6222 (*T. aestivum*)

- Released in 2010 for HF:TS of PZ, Early maturing
- Highest yielding with good quality
- Avg. yield 45 - 50 q/ha with yield potential 65 q/ha
- Used for chapati, bread, upma, biscuit, etc.



MACS 6478 (*T. aestivum*)

- Released in 2014 for TS-IR of PZ
- Average Yield- 45.0 q/ha Potential yield of 65.7 q/ha
- Better nutritional quality (Zinc 44.1 ppm, Iron 42.8 ppm, Protein 14%)
- **Excellent chapati**, biscuit and bread quality



MACS 3949 (*T. durum*)

- Released in 2017 for HF:TS conditions of PZ
- Better nutritional quality (Zn 40.6 ppm, Fe 38.6 ppm, Protein 12.9%)
- High yielding (Avg. 46 q/ha with potential yield of 64.3 q/ha)
- Good milling (Test weight 81.4 kg/hl)
- Good pasta making quality (7.25 out of 9)
- Used for rava, suji halwa, kheer, macaroni, etc.



BREEDER SEED PROGRAMME

- MACS-ARI produces breeder seed of wheat varieties and supplies it to seed multiplying agencies MSSC, NSC, SFAC, TSF and farmers for further multiplication.
- Total of about 645 quintal of wheat breeder seed of various wheat varieties MACS 6222, MACS 6478, MACS 3949, MACS 3125, MACS 2496 and MACS 2971 is produced during last five years and our varieties are spread over 2.5 lakh ha area in Peninsular zone.

BIOFORTIFIED WHEAT VARIETIES DEVELOPED

MACS 4028 (*T. durum*)

- Notified in 2018 for RF, LF: TS conditions of PZ
- Average yield 19.3 q/ha with potential of 28.7 q/ha
- Better nutritional quality (Zn 40.3 ppm, Fe 46.1 ppm, Protein 14.7%)
- Excellent milling quality
- Used for rava, suji halwa, pasta, macaroni, kheer, etc.



MACS 4058 (*T. durum*)

- Notified in 2020 for TS- RI condition
- Resistant to both black and brown rusts
- Early flowering (53 days); Good for pasta
- Better nutritional quality protein 12.82%, Zinc 37.8 ppm & Iron 39.5 ppm
- Average yield: 25-30 q/ha with potential yield: 38 q/ha



SOYBEAN VARIETIES DEVELOPED

MACS 1460



Suitability

- Rained condition
- Southern, North Eastern Hill and Eastern zone of India

Short duration

- Matures in 90 days
- Highest per day productivity of 35 kg/day

Yield

- 22-38 q/ha seed yield
- Bold seed, with 41 % protein and 17.64% oil



Contribution of MACS Soybean varieties in Maharashtra state for the last 10 years



MACS 1520



Suitability

- Rained condition
- Central zone of India

Mid duration

- Matures in 100 days
- Photo insensitive

Yield

- 21-29 q/ha seed yield
- Bold seed, with 40 % protein and 18.50 % oil



MACS 1407



Suitability

- Rained condition
- Eastern zone of India

Mid duration

- Matures in 104 days
- Good seed germinability

Yield

- 20-30 q/ha seed yield
- Shiny seed, with 41 % protein and 19.80 % oil



MACSNRC 1667



Food use

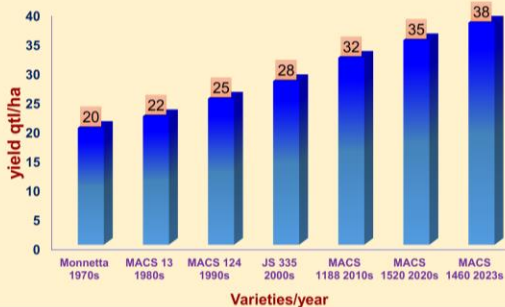
- Kuntz Trypsin Inhibitor free variety
- Suitable for soya based food industries

Mid duration

- Matures in 96 days
- Suitable for Southern zone

Yield

- 21 q/ha seed yield
- Bold seed, with 40 % protein and 19.01 % oil



Incremental progress in high-yielding MACS soybean varieties in the last 50 years

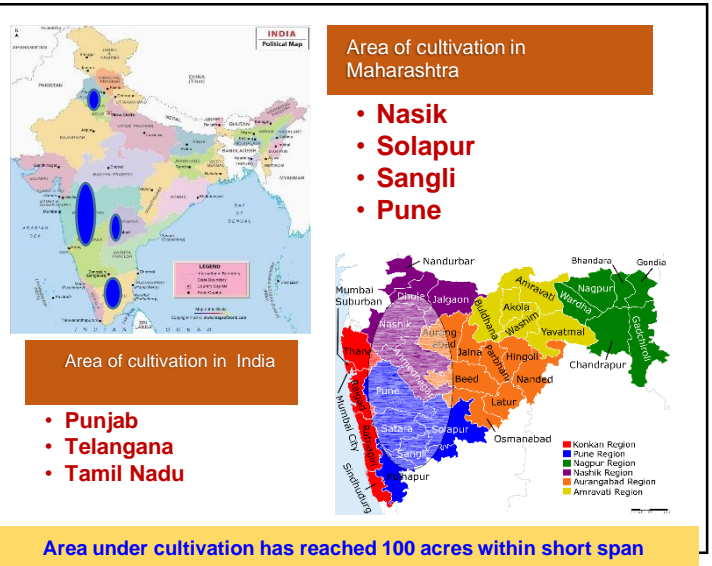
Grape variety ARI 516



- Multipurpose variety
- Moderately vigorous, high yielding with 15-20 kg/ vine yield
- Early maturing (110-120 days)
- Elongated bunches with round black size berries
- Unique flavour with good taste.
- High T.S.S. 22-24^o B
- Juice 68-70 per cent
- Presence of one soft seed

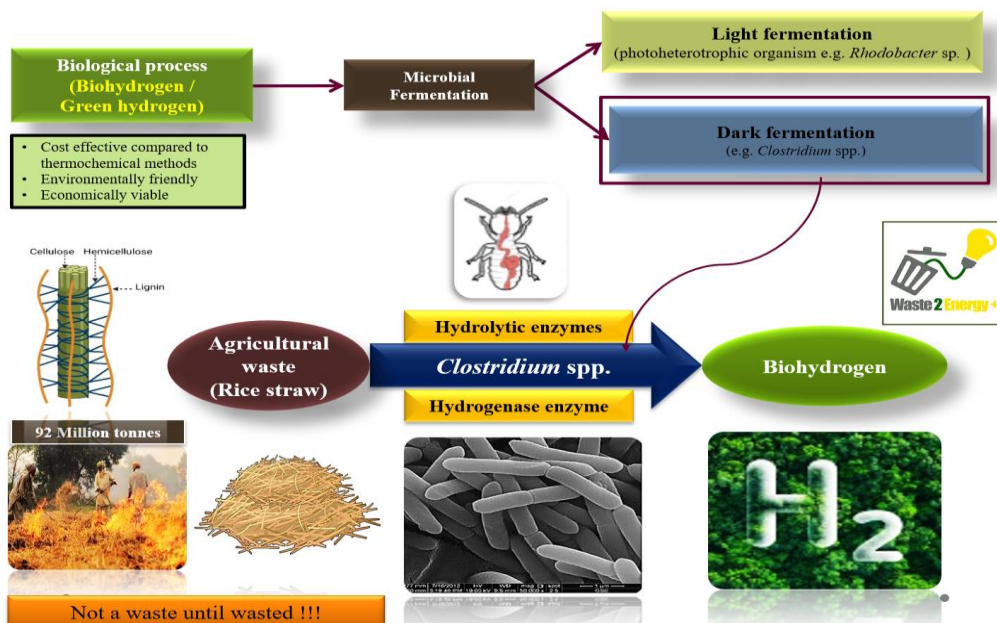
This is the first grape variety to be notified under AICRP

- ✓ Highly adaptable variety in diverse climatic conditions
- ✓ Moderately resistant to a majority of fungal diseases and requires less inputs in terms of labours, pesticides, other chemicals, growth hormones etc. leading to higher benefit:cost ratio



Tech-Transfer to KPIT Technologies Ltd.

KTLARI StrawH2Gen: Biohydrogen, a fuel for future



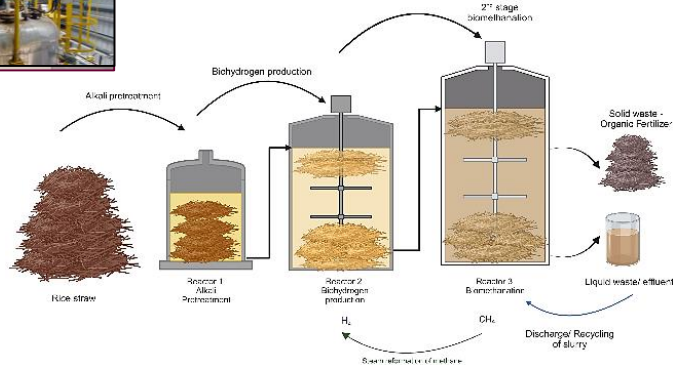
Utilization of agricultural wastes as biohydrogen feedstock could effectively turn waste into treasure and achieve the purposes of energy conservation and pollution reduction. This sustainable microbial process developed for the biohydrogen production from rice straw can facilitate decentralized production of biohydrogen reducing the transportation cost and increasing the techno-economic viability of the process and pave way for an increase in technologies for biohydrogen production

Large scale anaerobic digestion setup



Process operation	
Temperature	-30° C
pH	5.5 - 6
Hydraulic Retention Time	10 days

Anaerobic digestion	Productivity (continuous mode)
Biohydrogen production	~60 L/kg TS per day (feed added)
2 nd stage bio methanation	~260 L/kg TS per day (feed added)
Hydrogen yield after steam reformation of 260L/kg CH ₄	546L of H ₂ / 260L CH ₄ (Efficiency of SMR (~70%))
Hydrogen yield after steam reformation of 1L Methane	2.1 L of H ₂ /L CH ₄ (Efficiency of SMR (~70%))
Total Hydrogen yield per kg rice straw	606 L/kg TS per day (feed added)



Tech-Transfer to GPS Renewable

ARI 'BioStrawGas': unleashing the power of microbes to mitigate pollution and extract renewable energy (Rice straw to methane)

ARI 'BioStrawGas' Technology:

- ✓ Biomethanation of Rice straw without thermo-chemical pretreatment
- ✓ > 300 L Methane/kg VS of rice straw with >50% methane content in biogas
- ✓ High SLR; Low HRT of 15 days
- ✓ Steady-state operation without souring for > 500 days
- ✓ Eco-friendly & cost-effective process



Feed = Rice straw + Nutrient solution + Nitrogen source



Orpinomyces sp.

Daily feed contains:

1. Rice straw (particle size 2-50 mm)
2. Nutrient solution (To support growth of microbial community)
3. Inorganic nitrogen source (di-Ammonium phosphate)
4. Anaerobic fungal culture (*Orpinomyces* sp., 1% v/v)



Biomethanation of rice straw in anaerobic digesters (60L)

REACTOR OPERATIONAL CONDITIONS

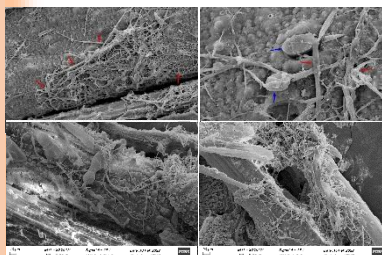
- ❖ Solid loading rate (SLR) = 10.5 %
- ❖ Temperature = 39±1 °C
- ❖ pH = 6.9±0.2
- ❖ C/N ratio = 30:1
- ❖ Hydraulic retention time (HRT) = 15 days

The cow dung slurry as the source of Methanogens in the reactor



PERFORMANCE OF THE AD PROCESS

- ❖ Biogas yield = > 600 L / kg VS / day
- ❖ Methane yield = > 300 L / kg VS / day
- ❖ Methane content in biogas = > 50%
- ❖ Volatile solids reduction = > 59%
- ❖ Potential to generate power = 3kWh/kg VS



Colonization of anaerobic fungus on rice straw (SEM image)

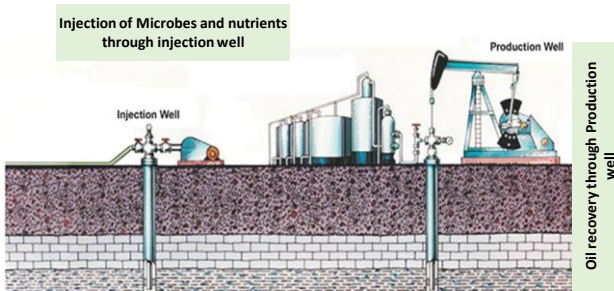


Digested slurry

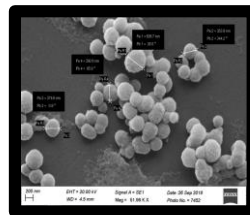
Tech-Transfer to IRS-ONGC

PetroBee: Unique Microbes to Enhance Oil Recovery

Microbial Enhanced Oil Recovery (MEOR), a low-cost tertiary oil recovery process involves the injection of efficient microbes along with suitable nutrients into the reservoir to promote *in situ* microbial growth and desired metabolite production, for enhancing oil recovery



Microbial process for enhanced oil recovery from high temperature (> 100°C) depleting oil reservoirs



Thermococcus petroboostus 101C5



Thermostable nutrient medium



Highest light oil recovery of 56.5% was obtained by 101C5 at 101 °C

Field trial of PetroBee in South kadi, Gujarat



ARI, in collaboration with IRS-ONGC, developed an effective MEOR process suitable for harsh reservoir conditions, exhibiting a striking oil recovery rate improvement of >200%

- ✓ Oil reservoir-compatible MEOR process
- ✓ Safe Microbial Formulation for Oilfields
- ✓ Efficient in recovering crude oil from high temperature oil reservoirs of the Indian subcontinent (> 90 °C)
- ✓ Technology to Reduce India's Foreign Oil Dependency

~ Rs 3 Lakhs
(Customized Nutrient Suite)



~ Rs 3 Lakh
(Infrastructure)



~ 107kl (673 barrels)
Oil Recovery After MEOR Application



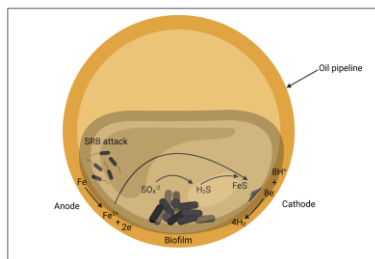
~ 22 Lakhs

Profit incurred : "3.6 times" the amount invested

BioSourShield: Bioagent for Controlling sulfate reducing bacteria (SRB) and H₂S in oil reservoirs

Problems caused by H₂S

- Causes souring of oil
- Extremely toxic to humans
- Deteriorates the quality of oil
- Corrosion** of pipelines (MIC) and a huge loss in infrastructure



Isolation of Host



• Collection of water/oil emulsion sample

Sample collection



Enrichment

- SSW medium
- Temperature: 37, 55, 60, 80, and 90 °C



• SRB were isolated from positive enrichments

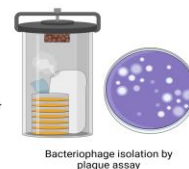
Isolation & Identification

Isolation of Bioagent

Collection of produced water, sludge sample, river water, sediment samples

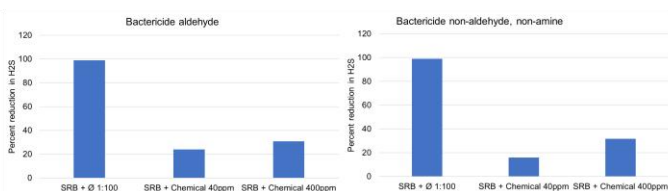


Enrichment of bacteriophages with host SRB



Bacteriophage isolation by plaque assay

EFFICACY OF BIOAGENT V/S CHEMICAL BIOCIDES ON SRB



SRB-lytic phage was observed to be more effective in comparison to the chemical biocides



Bioagent inhibited the SRB growth and H₂S production up to 90% after 28 days of incubation

SALIENT FINDINGS

- ❖ Twenty-seven sulfur-reducing bacteria (SRB) were isolated, representing four SRB species from five genera.
- ❖ A specialized phage was isolated as a biocontrol agent against SRB.
- ❖ Developed bioagent could inhibit SRB growth up to 90 – 99%.
- ❖ Developed Bioagent more efficient than the chemical biocides.

Tech-Transfer to Vikalpa Technologies

BioSanitize: A microbial process to reduce pathogenic load and malodour of human night soil

ARI has developed a unique microbial formulation for effective disposal of excreta on site to make it pathogen-free and to reduce malodour. This technology has been effectively implemented during Ashadhi Ekadashi Palakhi Sohala on site in Pandharpur and Baramati.

Spraying of ARI-Vikalpa consortium after defecation



Project sponsored by
Maharashtra
Pollution control
Board and Municipal
Councils



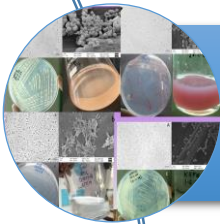
Outcomes of the Project:

- ❖ Area almost odour free
- ❖ Sanitisation of excreta and food waste
- ❖ Almost no fly and mosquito incidence
- ❖ Facilitated effective Epidemic breakout control
- ❖ Result appreciated by Pilgrims, Citizens, Municipalities

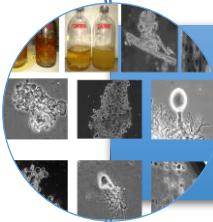
Other anaerobic technologies



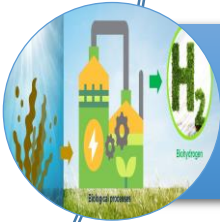
Development of Two Stage Anaerobic Bacterial Process for butanol production from industrial waste



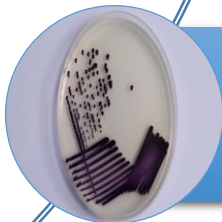
Methanotrophs: diversity & applications in biotechnology and enhancing methane mitigation



Fibrolytic anaerobes for efficient degradation of ligno-cellulosic biomass for renewable energy applications



High biohydrogen yielding *Clostridium* sp. isolated from sludge of distillery waste treatment plant



A microbial process is developed for the bioremediation of oil field produced water for its recycle and reuse

NANOCRYSTALLINE SILVER GEL

a broad spectrum antimicrobial formulation



A completely safe antimicrobial gel suitable for topical applications

Drug Controller of India (DGCI) approved formulation

Useful in the management of both acute and chronic wounds, first and second degree burns, pressure ulcers, venous ulcers, diabetic ulcers, donor sites, surgical incisions, minor cuts and abrasions etc.

Highly effective against

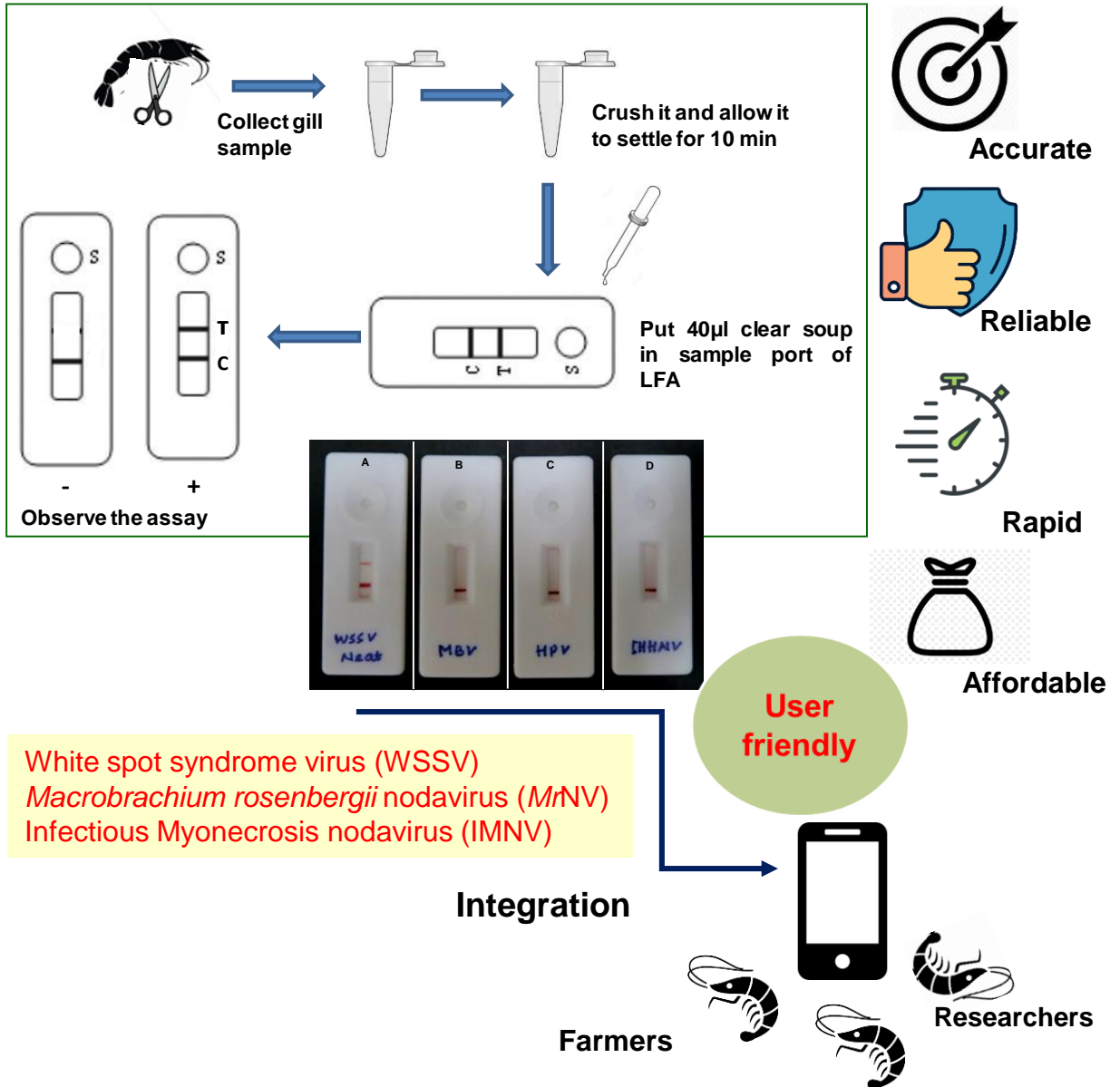
- *Staphylococcus aureus* (including Methicillin resistant *Staphylococcus aureus*, MRSA)
- Beta-hemolytic Streptococci
- *Proteus sp.*
- *E. coli*
- *Klebsiella sp.*
- Enterococci (including Vancomycin resistant Enterococci)
- *Pseudomonas sp.*
- *Acinetobacter sp.*

SALIENT FEATURES

- Hydrophilic gel that promotes wound healing
- Good rheological properties, spreadability and hence ease of application
- Forms an aseptic barrier ensuring vital gaseous exchange across wound tissue
- Effects synergistic with Ceftazidime, additive for Streptomycin, Kanamycin, Ampiclox, Polymixin B

ShrimpPathodetect

On-farm viral disease diagnostic for aquaculture

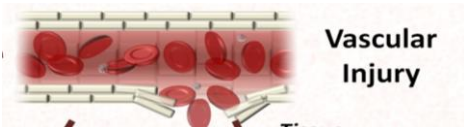


- Easy interpretation
- Limit-Of-Detection, L-O-D (40 virus particles)
- High specificity for viruses (no cross-reactivity)
- Early detection from hemolymph and gill tissues
- High reproducibility, accuracy

HEMOHALT BANDAGE FOR RAPID HEMOSTASIS



- Hemorrhage during injuries, defense or surgical operations, accidents leads to trauma-related deaths
- Adequate hemostasis after trauma is a big challenge in modern medicine
- Therefore, hemostatic treatments for reducing major blood loss due to traumatic injuries can save many precious lives



HEMOHALT BANDAGE Indian Patent Granted 2023



HOW IT WORKS

CHITO GAUZE AND ITS COMPONENTS REACT WITH BLOOD VESSELS AND CREATES A ROBUST SEAL

ADVANTAGES

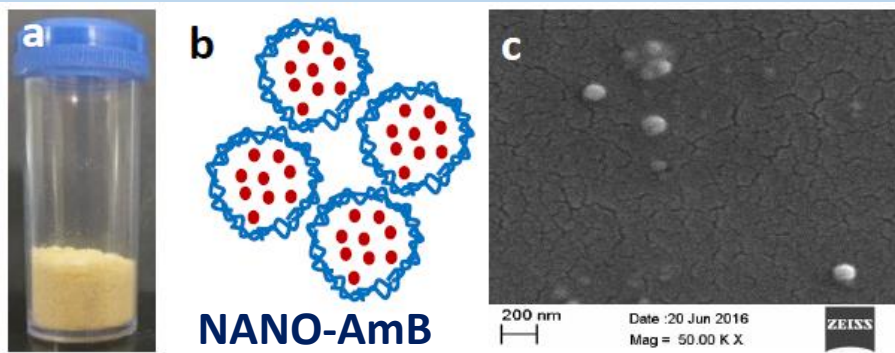
- Saves lives in accidents / battle field / encounter.
- Reduces disability, damage to organs and limbs
- Blood loss is minimised before hospitalization
- Hospital expenses reduced
- Import substitute to foreign brands like – Celox, Chitoclot etc.

NANO-AmB

FOR EFFECTIVE ANTIFUNGAL ACTIVITY AND REDUCED TOXICITY

- Resistant Fungal infections among immunocompromized are difficult to treat
- AmphotericinB an effective antifungal is highly nephrotoxic
- Entrapment of AmB in nano vehicles can reduce the toxicity with slow sustained release and enhanced biocompatibility

NANO-AmB: an effective antifungal agent Indian Patent Granted 2023



Encapsulation of AmB in polymeric nanovehicles showed *in vivo* effective anti-fungal activity and reduced toxicity with slow sustained release of the drug

TECHNOLOGY

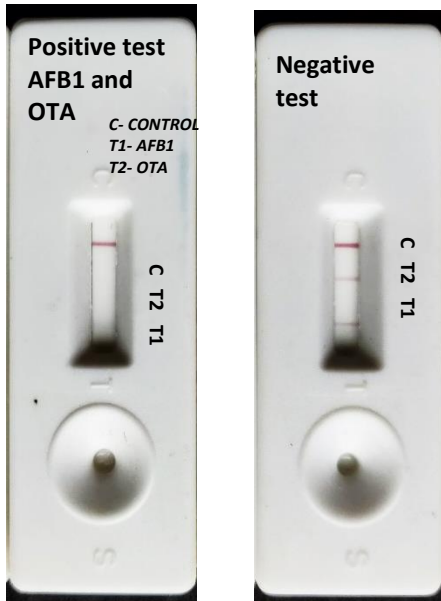
The present invention includes a synthetic one-pot procedure for preparing the drug encapsulated polymeric nanoparticles.

SALIENT FEATURES

- Effective antifungal activity at half the dose of free drug
- Reduced nephrotoxicity *in vivo* with repeated dose toxicity
- Hemocompatible
- Greater safety and biocompatibility
- Can contribute to reduced hospitalization and costs

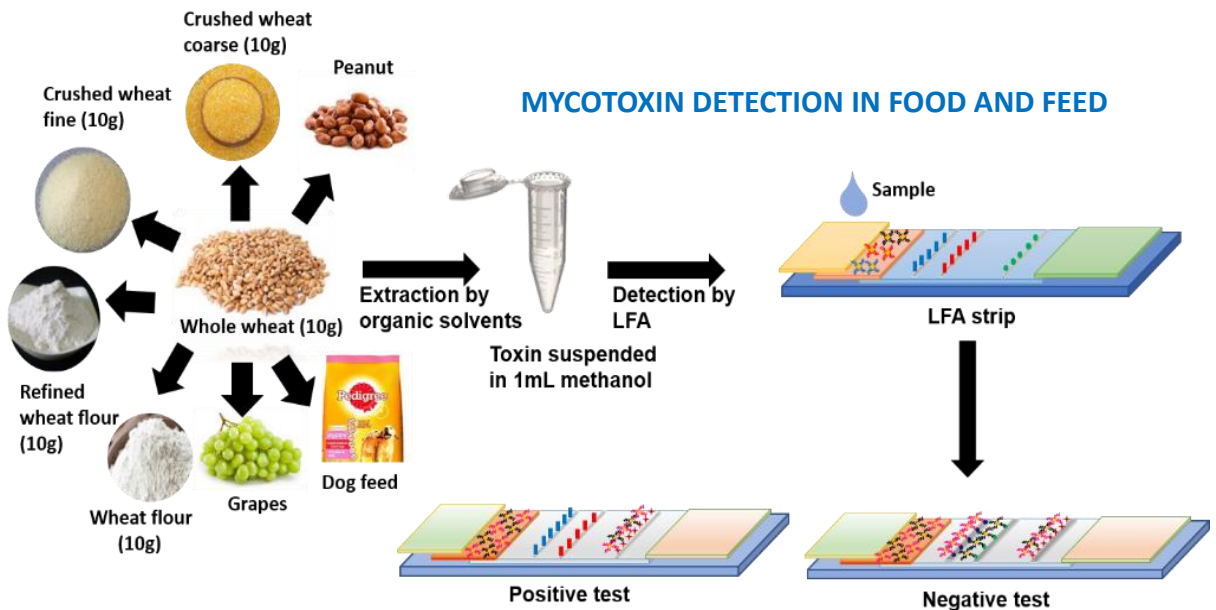
RAPID MULTIPLEXED LFA FOR ON-SITE AFLATOXINB1 AND OCHRATOXIN DETECTION FROM FOOD AND FEED

Competitive LFA for simultaneous on-site AFB1 and OTA detection



Method	Lateral Flow
Time	25 min
Sample volume	100 ul
Sensitivity	17.5 ppbl AFB1 17.5 ppb OTA

- Competitive assay, absence of T2 and T1 bands signifies the presence of toxins above corresponding to ≥ 17.5 ppb
- Permitted limits by FSSAI is 15 ppb for AFB1 and 20 ppb for OTA
- Applied for Indian Patent



ADVANTAGES

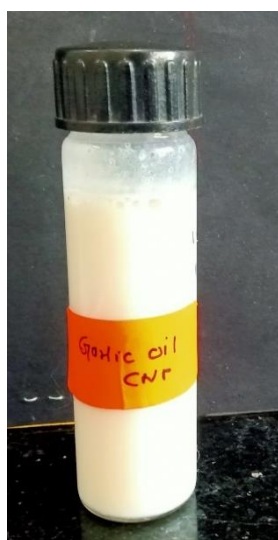
- Compliance with the FSSAI regulatory limits
- User-friendly on-site LFA for mycotoxin detection and food safety at every stage of food production
- Reduce the illness due to mycotoxin contamination
- Contribute to food and animal feed trade and compliance for trading

ESSENTIAL OIL NANOFORMULATION AS BIOPESTICIDE FOR CONTROL OF MEALYBUG



Mealybug

- Mealy bug (*Maconellicoccus hirsutus*) suck the plant sap causing plant stunting and yellowing
- Often leads to sooty mold infection.
- Transmits viral plant diseases like Leaf curl disease
- Woolly coat makes insecticides ineffective



**Essential oil nano-
formulation biopesticide
for mealybug control**

**Technology transferred to
SKR Group, Wardha**



Live



Dead mealybug

Efficacy in plant bioassays

Citronella and Garlic oil nanoformulation

- ✓ Efficacy data in plant bioassays
- ✓ Effective dose is 1:100 dilution of the ONF
- ✓ 50 ml is diluted to 5L for field application