SOME NEW ADDED TO THE LICHEN FLORA OF ODISHA

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Abstract

Satkosia Hill range is one of the prominent range of Odisha rich with a huge diversity of phanerogams. While exploring the floristic composition of the area 10 species of unknown lichen samples were collected which were critically studied for their taxonomic characterization and were found to be new records for Odisha. The newly identified lichen taxa included Anisomeridium biforme (Borr.) R.C. Harris, Anisomeridium tamarindi (Fee) R.C. Harris, Arthonia radiata (Pers.) Ach., Dirinaria picta (Sw.) Clem. & Scheer, Lecanora achroa Nyl., Lecanora interjecta Müll.-Arg., Lecanora leprosa Fée, Lepraria incana (L.) Ach. and Lepraria membranacea (Dicks.)Vain. which were recorded for the first time as not reported earlier. This paper presents a detailed taxonomic enumeration, photographs and pertinent information based on collections of lichen specimens.

Key words: Phanerogams, New records, Satkosia, Odisha.

Introduction

The ‘Satkosia Hill range’ lies between 21° 25’ North latitude and 86° 22’ East longitudes with an average elevation varying between 575 m to 850 m. The survey area has the highest temperature of about 44°C and lowest temperature of about 7°C with an average rainfall of about 1425 mm. ‘Mahanadi’ the largest river of Odisha, passes through its periphery. This hill range has a dry deciduous type forest with Cleistanthus collinus and Anogeissus latifolia of frequent occurrence. In this forest, the proportion of Sal was less as compared to that in the north Indian moist deciduous forest with a maximum frequency of 10% of the total vegetation. The other co-dominant tree species included Lannea cormandelica, Lagerstroemia parviflora, Diospyros melanoxylon, Terminalia tomentosa and Aegle marmelos. Shrubs, such as Helicteres isora, Flemingia semialata and Indigofera cassioides were prominently found in this region which provided an ideal habitat for the growth of several species of lichens with a widespread diversity. The present work is a novel attempt to explore the lichen diversity of the area under study although exhaustive floristic inventory were done by earlier workers (Haines, 1921-1925; Saxena and Bramham, 1994-1996).

Materials and Methods

Extensive field tours were conducted at regular intervals during 2016-2018 in various locations of the study area to locate the occurrence of various lichen species before they were digitally photographed in their natural habitats in association with their respective hosts. The lichen specimens were collected using the standard method and brought to the laboratory for characterization and taxonomic analysis. All the prescribed procedures such as anatomical and chemical investigations were conducted towards confirmation of the identity of the collected samples. The species were identified with the help of pertinent literature (Awasthi, 2007) and the taxa were confirmed in consultation with the Herbarium Unit in the Lichenological laboratory, National Botanical Research Institute (NBRI), Lucknow (India). All the voucher specimens were deposited in the herbarium of Lichenological Laboratory at NBRI, Lucknow.

Results and Discussion

During the present investigation a total number of 51 species of lichens were collected and documented which belong to 34 numbers of genera included under 28 families Caliciaceae was found to be the most dominant family represented by 5 genera followed by Physciaceae.

The analysis of the inventory data revealed 10 newly recorded lichen species namely Anisomeridium biforme (Borr.) R.C. Harris, Anisomeridium tamarindi (Fee) R.C. Harris (Monoblastiaceae), Arthonia radiata (Pers.) Ach. (Arthoniaceae), Dirinaria picta (Sw.) Clem. & Scheer, (Caliciaceae), Lecanora achroa Nyl., Lecanora interjecta

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Müll.-Arg., *Lecanora leprosa* Fée, *Lecanora pseudistera* Nyl. (Lecanoraceae), *Lepraria incana* (L.) Ach. and *Lepraria membranacea* (Dicks.) Vain. (Stereocaulaceae) which were not reported earlier from any part of the Odisha State since they did not match with any species recorded in the earlier flora of the region (Nayak et al., 2016). The details of the new records of the lichen species are enumerated below.

**Enumeration**

**Anisomeridium biforme** (Borr.) R.C. Harris, in *V. müzda*, Folia Geobot. Phytotax. 20: 207. 1978. (Family-Monoblastiaceae)


**Vernacular name:** Asamipatra (O).

**Thallus:** crustose, leioic, asymmetrical, uninterrupted, not plunged in the substrate, effuse or delineated by a graciliform, merulius hypothallus, ecoricate. **Upper surface:** leucoish to prasino-cinereous. **Photobiont:** a chlorophycean alga, *Trentepohlia*, cells 6-14 µm across. **Perithecia:** semispherical, nigrescent, hemi-plunged in the thallus, 0.4-0.7 mm diam. **Perithecial wall:** nigrescent, with a properly distinguished involucrellum, 48-100 µm thick. Lower wall: pale or achromate, uninterrupted beneath the hamathecium. **Hamathecium:** ramified pseudoparaphyses, anastomosing above the asc; **filaments:** ca. 1.2 µm wide, not sprinkled with oleic globules. Asc: cylindrical, ca. 68-100 x 10.5 µm, with eight, uniseriately arranged ascospores. **Ascospores:** perspicuous, oval, uniseptate with a scarcely submedial euseptum, 12-16 x 5-6 µm, not ornamented, devoid of a gelatinous sheath. **Pycnidia:** abundant, dispersed all over the thallus or in perpusillus bunches probably puzzled with perithecia; two types: 100-200 µm diam. or 38-100 µm diam. **Conidia:** subglobular to ellipsoid macroconidia, respectively 2.2-4 x 1.7-2.8 µm or globuliform microconidia, 1-1.6 µm diam. **Spot tests:** all -ve, UV. **Secondary metabolites:** not observed (Fig. 1A).

**Substrate and ecology:** Often found on smooth or scabrid bark of latifoliate trees like *Mangifera indica*, *Tectona grandis* etc.

**World distribution:** Cosmopolitan

**Specimen examined:** Angul, Satkoshia 18.01.2018, RM 18-033347 (Herbarium, NBRI, Lucknow, Uttar Pradesh).

**Notes:** This species is recognized from other species by the pumilus, generally oval to ellipsoid, normally uniseriate ascospores and ascomata with apical ostiole. Ascomata, ascospores and conidia of the species very much related to *A. tamarindi* (Fée) R C. Harris, which has spindle shaped, angustiformly ovoid to oblong-ovoid ascospores. This may be confused with *Acrocordia gemmata* (Ach.) A. Massal. whose perithecia are grandiform and pycnidia not abundant and devoid of nigrescent prothallus.

**Anisomeridium tamarindi** (Fée) R.C. Harris in S.C. Tucker & Harris, Bryol. 83: 4. 1980. (Family-Monoblastiaceae)


**Vernacular name:** Asami patra (O).

**Thallus:** crustose, endophloeodal, asymmetrical, 1-4 (-7) cm across, candid to leucoish cinereous, leioic, effuse or delineated by atro-phaeoic or nigrescent prothallus, ecoricate **photobiont:** a chlorophycean alga *Trentepohlia*, cells 7-14 µm across **ascomata:** perithelial, abundant, generally unitary, frequently two-three agglomerated, semispherical, frequently emergent, generally hemi-plunged, 0.27-0.6 x 0.21-0.33 mm. **ostiole:** apical, flat, inapparent; wall interrupted beneath the hymenium, clypeate, carbonized, 51-86 µm thick, K+ porraceous **hymenium:** achromate, not sprinkled with oleic globules, I-.

**Pseudoparaphyses:** ramified and anastomosing 1-1.6 µm thick. Asc: clavulate, octospored, 51-67 x 9-13 µm; **ascospores:** biseriate, achromate, spindle shaped, angustiformly oval to oblong-ovoid, or angustiformly ellipsoid, orthic to scarsely campylar, uniseptate ascospores and pusillus, clavulate asci.

**World distribution:** Tropical to pan tropical.

**Specimen examined:** Angul, Satkoshia 18.01.2018, RM 18-033347 (Herbarium, NBRI, Lucknow, Uttar Pradesh).

**Notes:** This species is identified by its UV- thallus, spindly shaped, angustiformly oval to oblong-ovoid or angustiformly ellipsoid, orthic to scarsely campylar, uniseptate ascospores and pusillus, clavulate asci.
**Dirinaria picta** (Sw.) Clem. & Schear(Sw.) Schaer. ex Clem., Gen. Fung.: 323. 1931. (Family: Caliciaceae)


**On bark and wood of**

**Thallus**: foliose, appressed to clumped up to the tips of the lobe, 2-9 cm in diam. adnate to stiffly adnate, dichotomously pinnately or subpinnately lobed **lobes**: radiating, continuous, convergent, plane or convex but occasionally scarcely concave near apices, 0.5-1 mm wide, apices separate, not flabelliform towards the lobe tips **upper surface**: canescent, caerulo-canescens or almost candid, lustrous, occasionally pruinose or epruinose, sorediate, edactylate **soredia**: farinoid, in laminal, globular, ±capitate soralia, 0.5–1.0 mm wide **pseudocyphellae**: present, but inconspicuous, marginal, occasionally also laminal, generally confined to the circumsribal parts of the lobes, sometimes reticulately convergent **medulla**: white, lower part rarely aurantiate or flavid near the lobe tips **lower surface**: carbonaceous in center, paler towards the tip of the lobe, chrozinate. **Apothecia**: occasionally present, astalked to ±constricted at the base laminal on thallus, 0.5-1.5 mm wide **disc**: nigrescent, devoid of pruina **ep hymenium**: pale phaeoic, 7-10 mm thick **hymenium**: achromate, 75- 90 mm thick **hypothecium**: rubro-phaeoic to phaeo-nigrescent, 118–200 mm thick, lenticulate **ascospores**: phaeoic, uniseptate, steno-elliptic, 12-22 x 4-9 µm. **Pyenia**: plunged in verrucae **Conidia**: bacillioid or spindle shaped, 3-4 x 0.8-1.2 µm. **Spot tests**: upper cortex K+ flavid, C-, KC-, P+ flavid; medulla K-, C-, KC-, P-. Secondary metabolites: upper cortex bears atranorin; divaricatic acid and few terpenes in trace amount present in the medulla part (Fig.- 1C).

**Substrate and ecology**: On bark and wood of *Shorea robusta*, *Cipadesa baccifera*.

**World distribution**: In all tropical regions of both the hemispheres.

**Substrate and ecology**: On bark and wood of *Shorea robusta*, *Cipadesa baccifera*.

**World distribution**: In all tropical regions of both the hemispheres.

**Specimen examined**: Angul, Satkoshia 18.01.2018, RM 18-033353 (Herbarium, NBRI, Lucknow, Uttar Pradesh).


**Vernacular name(s)**: Ghrootashroongi (O), Comma (E).

**Thallus**: crustose, endophloeodal, not prominent, plunged lowly rotund to asymmetrical, 1-2.7 cm across, leuco-cinereous to flavo-cinereous, delineated by a nigrescent line, leioie, epruinose **photobiont**: a chlorophycean algae *Trentepohlia*, cells 6-13 µm across. **Ascomata**: arthoniod, diverse shaped, subasterik,1-1.6 mm diam., linear, asymmetrically ramified, 1-1.7 x 0.1-0.3 mm, 64-84 µm high **disc**: a mazedium, merulius, campestrial, epruinose, in center, carboneous, **hymenium**: achromate, 9-15 µm thick, K+ porraceous, 1-15 µm thick, **hymenium**: phaeoic, 34-49 µm high, 1+ endividuous **hypothecium**: achromate to pale phaeoic, 11-28 µm thick, K+ porraceous, 1+ endividuous, **K+** deep endividuous **paraphyses**: ramified and anastomosing, 1-3 µm thick; tips consistent, phaeo walled, frequently with deep phaeoic apical caps, 2-4 µm thick **asci**: clavate to subglobular, octo spored, 34-45 x 19-25 µm, gelatinous **tholus**: crassus; amyloid, not racting with iodine, with amyloid tube, ring *Collema, Micarea, Porpidea, Psora* types etc. **ascospores**: achromate, oblong-ovate, triseptate, apical cell reduced, 9-19 x 4-7 µm, central, perispore and epispore: not apparent. **Spot test**: Thallus K-, C-, KC, P-, 1-, KI+ pale caeruleus.

**Secondary metabolites**: no lichen substances found (Fig.- 1D).

**Substrate and ecology**: Bark, cork, branches and twigs of various trees like *Madhuca indica* var. *latifolia* and *Mangifera indica*.

**World distribution**: Africa, Madagascar Australasia, South and Central America and Arctic zone.

**Specimen examined**: Angul, Satkoshia 18.01.2018, RM 18-033362 (Herbarium, NBRI, Lucknow, Uttar Pradesh).

**Lecanora achroa** Nyl. in J.M. Crombie, J. Bot. 14:263.1876. (Family- Lecanoraceae)

**Vernacular name(s)**: Abrunti Manjupatra (O), Rim (E).

**Thallus**: crustose, unitterupted or fissured-areolate **prothallus**: carbonaceous to caerulo-phaeoic. **areoles**: plane, psilic, obscure, ecarticate **surface**: flavo-candids to flavo-canescent or flavo-prasinus or pale porraceous to prasino-candids, leioie, epruinose, with an inconspicuous margin, esorediate. **Apothecia**: astalked, 0.4-0.9 mm in diam., lecanorine **disc**: aurantio-phaeoic.
or flavo-phaeoic, flat or convex, epruinose or moderately leucoish- cinerous, pruinose margin: concolorous with thallus, psilic or crassus, persistent or becoming excluded, even, efflexuose, leioic, entire or little warty, parathecial annulus lacking amphitheicum: persistent, with innumerable algal cells, massive crystals are present which are insoluble in K, corticated cortex: prominent, basally not crassus, interspersed with abundant teesny- weeny crystals, pellucid, 15-40 µm thick laterally and basally paraphyses: vitreous, bears puny crystals insoluble in K epithymenum: flavo-phaeoic to aurantiophaeoic, with pigment and crystals soluble in K. hymenum: vitreous, limpid. paraphyses: moderately ramified and scarcely thickened up to 2.7 µm wide apically, lack of any pigment. subhymenum: diaphanous, 14-21 µm thick hypothecium: pellucid, lack of oleie droplets. asci: club shaped, ocatospored. ascospores: pellucid, simple, ellipsoid or broadly ellipsoid, 9.5-17.5 x 5.5-9.5 µm; wall: > 1 µm thick. Pycnidia: not found. Spot tests: K+ flavid, C- or C+ aurantiate, Pd+ pale aurantiate. Secondary metabolites: arthothelin, usnic acid (major), atranorin, chloroatranorin, 2, 5-dichloronorlichexanthone and 4, 5-dichloronorlichexanthone (minor) (Fig. 1F).

Substrate and ecology: On bark of Boswellia serrata.

World distribution: Pantropical in distribution, Central and South America, New Zealand, Australia, India etc. Specimen examined: Angul, Satkoshia 18. 01. 2018, RM 18-03339 (Herbarium, NBRI, Lucknow, Uttar Pradesh). Lecanora leprosa Fée Essai Crypt. Écorc. 118. 1824. (Family- Lecanoraceae) Vernacular name (s): Bhasma Manjupatra (O), Rim lichens (E).

Thallus: crustose, graciliform to grossus, campstral, uninterrupted or sattered-cornuate to verruculose, flavo-candin to flavo-ravus or prasino-ravus, epruinose soredia: unknown prothallus: not observed or leuco-cinereous Apothecia: plunged when old, becoming estipitate, 0.3-0.6 (-1.1) mm diam. disc: pale aurantiophaeoic, not or scarcely pruinose margin: conconromous with the thallus, psilic to grossus, entire, occasionally cornuate cortex: pellucid, ±gelatinous, sprinkled with puny crystals, discrete, 9-15 µm thick laterally and 14-26 µm thick basally amphitheicum: with mega crystals undissoluated in KOH (Pulicaris-type) parathecium: vitreous, 9-16µm thick, with abundant parvulus crystals undissoluated in KOH. ephymenum: flavo-phaeoic, ca. 9-16 µm thick, with innumerable diminutive crystals (Pulicaris-type); pigmentaion and crystals undissoloved in KOH, hymenum, subhymenum and hypothecium: perspicuous paraphyses: scarcely cladeate and crassus apically ascospores: ellipsoidal, 9.5-15 x 7-10.5 µm. Spot tests: thallus and apothecial margin K+ flavid, C+ aurantiate, Pd+ pale aurantiate. Secondary metabolites: arthothelin, usnic acid (major), atranorin, chloroatranorin, 2, 5-dichloronorlichexanthone and 4, 5-dichloronorlichexanthone (minor) (Fig. 2A).

Substrate and ecology: On bark of Madhuca indica.


Thallus: crustose, coruant to lowly cornuate, flavo-cinereous to prasino-cinereus, epruinose. soredia: lacking prothallus: not observed Apothecia: astaked, 0.4-0.7 mm diam. disc: dark aurantiophaeoic to aethon, epruinose or scarcely cinero-pruinose margin: same as that of the thallus, graciliform, lowly cornuate cortex: perspicuous, sprinkled with teesny-weeny crystals, 9-32µm thick laterally and basally amphitheicum: with big crystals undissoldued in KOH (Pulicaris-type) parathecium: perluvidulus, 14 µm thick, with abundant puny crystals undissolued in KOH. ephymenum: rubrophaeoic, ca. 9-16 µm thick, with innumerable diminutive crystals (Pulicaris-type); pigmentation and crystals undissoloved in KOH, hymenum, subhymenum and hypothecium: perspicuous paraphyses: scarcely cladeate and crassus apically ascospores: ellipsoidal, 9.5-15 x 7-10.5 µm. Spot tests: thallus and apothecial margin K+ flavid, C+ aurantiate, Pd+ pale aurantiate. Secondary metabolites: arthothelin, usnic acid (major), atranorin, chloroatranorin, 2, 5-dichloronorlichexanthone and 4, 5-dichloronorlichexanthone (minor) (Fig. 2A).
Specimen examined: Angul, Satkoshia 18.01.2018, RM 18-03339 (Herbarium, NBRI, Lucknow, Uttar Pradesh).

Lecanora leprosa Fée Essai Crypt. Écorc. 118.

1824. (Family - Lecanoraceae)

Vernacular name(s): Bhasma Manjupatra (O), Rim lichens (E).

Thallus: crustose, graciliform to grossus, campestral, uninterrupted or scattered-cornuate to verruculose, flavo-
candid to flavo-ravus or prasino-ravus, epruinose soredia: unknown prothallus: not observed or leuco-cinereous Apothecia: plunged when old, becoming estipitate, 0.3-0.6 (-1.1) mm diam. disc: pale aurantiate to flavo-phaeoic, not or scarcely pruinose margin: conchromous with the thallus, psilic to grossus, entire, occasionally cornuate cortex: pellucid, ±gelatinous, sprinkled with puny crystals, discrete, 9-15 µm thick laterally and 14-26 µm thick basally amphithecium: with mega crystals undissolved in KOH (Pulicaris-type) parathecium: vitreous, 9-16µm thick, with abundant parvulus crystals undissolved in KOH. ephymenium: pellucid or flavo-phaeoic, ca. 9-16 µm thick, with copiosus tiny crystals (Chlarotera-type); pigmentation quickly dissolved in KOH. hymenium and subhymenium: pellucid hypothecium: perspicuous or flavus to pallid-phaeoic paraphyses: cladulate and grossus apically. ascospores: tenuiformly ellipsoidal, 9.3-13.8 × 4.5-7.5 µm. Spot tests: thallus and apothecial margin K+ flavid, C–, Pd+ pale aurantiate Secondary metabolites: atranorin and gangaleoidin (major), chloroatranorin, chlorolecideoidin, leoidin and norgangaleoidin (minor) (Fig. 2A).

Substrate and ecology: On bark of Madhuca indica.

World distribution: Pantropical Central and South America, Australasia, India, etc.

Specimen examined: Angul, Satkoshia 18. 01. 2018, RM 18-033315 (Herbarium, NBRI, Lucknow, Uttar Pradesh).


Vernacular name (s): Kuta Manjupatra (O), Rim lichens (E).

Thallus: crustose, scattered-cornuate to areolate or lowly squamulose, bulliform, flavo-albus, to flavo-cinereous or leuco-cinereous, epruinose, occasionally nitid. soredia: lacking prothallus: absent apothecia: plunged when old, becoming epedicellate to moderately constricted at the base, 0.3-0.9 (-1.5) mm diam. disc: pale to dark rubro-phaeoic, epruinose; margin conchromous with the

Thallus: crustose, pulveraceous, placodioid, juncaceous, asymmetrical, strongly fastened to the substrate, forming a psilic strata of soredia, lobes inavident upper surface: deeply cinero-prasinus, frequently with a caerulo-vires tinge, or pallido-viridis or glaucus to albo-cinereus. sprout upon a common hypothallus prothallus: byssoid areaneculus, 'gossypinate' forming an asymmetrical, inconspicuously lobed margin, generally devoid of a prominent lip, not campyular soredia: diffusely, mostly farinose, up to 70(115)µm in diam., floccose, occasionally with pumilo-projecting hyphae, hyphae 2-5µm thick medulla: improperly developed or lacking, if present than candid photobiont: chlorococcoid, ca. 7-19 µm diam., other than Trentepohlia hypothallus: weakly to properly developed, lax, ‘lanate’, ‘gossypinate, rhizohyphae scanty or lacking granules: ectocrine, ill-developed, pollinarius (mealy) (18)-30–60(100) µm in diam., commonly even in size but ±fasciculating in bigger clusters, up to 100 µm, normally laxly compacted, particularly with some protruding hyphae. Spot tests: K- or sometimes K+ faintly flavid, C-, KC- or rarely KC+ violo-rubrus, P- or rarely P+ aurantiate, UV+ bright luteo-candid caeruleo-candid. Rare chemotype: (2): with anthraquinones in addition to the above mentioned substances: parietin, fallacinal, parietinolic acid and citreorosein; K+ purpuro-rubrus, C-, KC- purpuro-rubrus, Pd+ aurantiate. Infrequent accessories include gyrophoric acid, lecanoric acid, thamnolic acid and an unidentified terpenoid. Secondary metabolites: atranorin, zeorin, (major), divaricatic acid and nor divaricatic acid, occasionally parietin (Fig 2C).

Substrate and ecology: on acid bark of deciduous trees, sometimes on siliceous rocks, rarely on mosses, wood and soil; in more or less shadowed places. World distribution: cosmopolitan, except Arctic and Antarctic.

Note: Lepraria incana (L.)Ach. can be morphologically highly variable, occasionally forming relatively lax gossypinate cushions and rarely consisting of sparse or glutulate discrete soredia only.

Lepraria membranacea (Dicks.) Vain., Acta Soc. Fa. Fl. fenn. 49(no. 2): 265.1921. (Family - Stereocaulaceae)


Vernacular name(s): Jhilee Bhasmila (O): Dust lichen (E).

Thallus: crustose to lepidose, pallido-cinereous to flavo-candid, definite, composed of pulveraceous lobes, forming asymmetrical rosettiform structure to 3-4 cm wide, frequently becoming contiguous or confluent with another thallus, surface wrapped by a lax mass of convex granules or soredia, demolishing with age to form a powdery mass margin: with properly developed lobes to 3 mm long and wide, with an entire ±campestrial or generally conspicuously elevated rim, latiform towards the circinate tips soredia: fine to rough, generally ±globular, 38–70 µm wide, frequently bunched in consoredia 124–210 (–500) µm wide, pumilo-radiating hyphae may or may not be present medulla: prominent, candid hyphae: 2–6 µm thick. photobiont: cells are more or less spherical, 6–14 µm diam lower surface: a prominent hypothallus, cinero-candid to phaeo- or griseo-nigrus, rarely candid along margin of the thallus, forming a ± pachyform tomentum, rarely spreading well afar the thallus margin. Spot tests: Thallus K– or K+ flavid, C–, KC–, P– or P+ aurantiate or rubro- aurantiate, UV+ purpuro-caeruleus. Secondary metabolites: pannaric acid, roccellic acid/angardianic acid (major), atranorin ± purpuro-caeruleus. world distribution: Asia, North and South America, India, Europe and Africa etc.

Specimen examined: Angul, Satkosha 18.01.2018, RM 18-033357 (Herbarium, NBRI, Lucknow, Uttar Pradesh).

Conclusion

The authors have gone through relevant published literature (Singh and Sinha, 2010; Upreti 1996; Singh and Kumar, 2012; Nayak et al., 2015) and visited the NBRI Herbarium unit and the Herbarium of BSI Allahabad in Uttar Pradesh (India) to find out the occurrence, distribution and habitat of these species. It was observed that these species were not mentioned in any of the published papers on lichen group. On close examination of herbarium specimens and detailed scrutiny of literature published till date on these taxa, it can be claimed that these are new records for Odisha.

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