Did Romans have direct maritime trade contacts with Odisha on the Eastern Indian littoral?

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Kalinga, Utikal, Odra and Orissa are former names of the present state of Odisha with varied geographical boundaries in different periods of history. The exploration and excavations of Manikapatna, Palur, Radhanagar, Sisupalgarh, Talapada of Odisha have brought to light terracotta Roman bullae with Roman portraits, lamps, amphorae sheds and rouletted ware which suggested that these findings belong to the Roman early centuries (earliest of Christian era) and Roman mariners had maritime contacts with Odisha from the early historical period onwards, if not earlier. However, it is evident that Roman artefacts such as gold coins, amphorae, Terra Sigillata (Arretine ware), etc., are more abundant in peninsular India than in the rest of the country and these findings are limited in Odisha, but the reasons are not comprehensible. However, archaeological findings from the port and trade centres delineate maritime contacts of Odisha with Southeast Asian countries. Here we discuss the archaeological findings from the port sites of Odisha to understand the maritime contacts with Southeast Asian countries and the Roman Empire and examine why the Roman findings are comparatively less in Odisha than in other parts of India.

Keywords: Odisha, maritime trade, ports, Romans, Southeast Asia.

The recorded history of Odisha, east coast of India, starts from the 3rd century BCE onwards. In the annals of history, Odisha has been referred to as Udra or Odra Desa, Kalinga, Utikal, Orissa; now it has been renamed as Odisha. Archaeological findings, epigraphic, sculptural, literary and art evidence corroborate the maritime contacts of Odisha with Southeast Asian countries and the Roman Empire. However, the contacts between Odisha and Southeast Asia are more evident compared with those of the Roman Empire. Earlier studies suggest maritime contacts of Odisha with the Roman empire, Roman findings in Odisha, etc. Therefore, it is crucial to understand whether Odisha had direct trade contacts with the Roman Empire or not, and why the Roman findings are very limited in Odisha compared with peninsular India. As a result, in this study, the archaeological findings such as different types of pottery, amphorae, Roman coins, etc., found from ports and settlement sites of Odisha and neighbourhood are examined to understand the contacts between Odisha and the Roman Empire. An attempt has also been made to understand the reasons why Roman findings were limited in Odisha.

In the Indian Ocean maritime trade, during the early historical period, a wide variety of pottery was recorded from ports and trade centres along the east and west coasts of India. Pottery is a well preserved cultural material which can be traced along with other maritime trade materials, and it was one of the objects and medium used for the trade. The early historical period pottery namely Northern black polished ware (NBPW), rouletted ware (RW), knobbed ware (KW), stamped ware, amphorae and other artefacts were transported both by land and water routes. The discovery of identical pottery from a number

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of sites suggests regional and overseas trade and cultural contacts among the people and the existence of routes. All these ceramics are datable to the early centuries of the Common Era to the 3rd–4th centuries CE.

The first discoveries of NBPW were from Bhita, Sarnath and Taxila
dating to the early centuries of the Common Era. Before it was denoted as NBPW, it was known as black lustrous ware, the Greek black ware. Recent excavations at Ayodhya have yielded NBPW which is datable to 1000 BCE (ref. 9). NBPW has been reported from many coastal sites of West Bengal, Odisha, Andhra Pradesh, Tamil Nadu, Kerala, Maharashtra and inland sites of northern India (Figure 1). This ware was made of fine clay of the Gangetic valley, thin in fabric, well-fired, and grey to reddish coloured with a mirror-like thin film polish. The other significant aspect is that NBPW and punch marked coins (PMC) have been reported from excavations in the citadel of Anuradhapura and other Buddhist sites of Sri Lanka
dating to the early centuries of the Common Era. However, except Sri Lanka, NBPW is not reported from any other place of Southeast Asia and the Roman empire. During the NBPW period, significant progress was noticed in the technological skill and development of cities. The finding of NBPW along coastal and hinterland Buddhist establishments suggests the involvement of Buddhism in maritime trade network and linkages with traders as well as money-based economy.

RW is fine textured with rouletted designs such as parallelograms or diamonds, dots, triangles and wedges found on the base of the pottery. It was believed that RW was used on special occasions for offerings but not for daily usages; evidences show that RW was used for consuming food found in trench XIII of Arikamedu excavations in 1989–92 where as RW plate was discarded with chicken bones. This pottery has been reported from more than a hundred sites all over India (Figure 2). Majority of the sites are along the east coast of India and across the Bay of Bengal, namely from Sri Lanka
dating to the early centuries of the Common Era, Bangladesh, Myanmar, Java, Sumatra, Bali, Thailand, Vietnam, Malaysia, Yemen and Oman. Myos Hormos, Berenike and Coptos in Egypt. Moreover, RW sherds with Brahmi, Tamil-Brahmi, Sri Lankan Brahmi, Kharoshthi inscriptions and graffito marks have also been recovered from several sites in India and abroad. It is believed that these graffito marks and inscriptions could be the names of the traders or pot makers.

Generally, a boss or projection is found at the centre of the base of the KW along with and without concentric circles. Different fabrics of KW have been reported such as fine grey ware, red ware and black slipped ware. KW

![Figure 1. Northern black polished ware sites of India.](image1)

![Figure 2. Rouletted ware from different sites of India.](image2)
was found for the first time at Sisupalgarh and Jaugada, both are in Odisha^{29–31} (Figure 3a and b), belonging to the early centuries of the Christian era. Consequently, this pottery was reported from many coastal and hinterland sites of Odisha (Figure 4), Andhra Pradesh, and the Gangetic valley of Bengal^{16,32–34}. A black granite (reliquary) knobbed bowl was found in the ruins of a monastery in the north of Taxila, and high tin bronze knobbed bowls came from Nilgiri, Tamil Nadu, in megalithic context^{35–37}. Excavations at Ban Don Ta Phet and Khao Sam Kaeo in Peninsular Thailand have yielded knobbed vessels made of high tin bronze^{38,39}.

Stamped ware pottery is stamped with mostly linear and geometric combinations such as squares, triangles, double or triple parallel lines, including floral and faunal designs. The exterior of the whole pottery is decorated which extends up to the neck portion. Mostly, stamped ware was reported from the coastal sites of Arika-medu^{40,41} in Tamil Nadu, Jaugada in Odisha^{30}, Kottapatt-nam^{42} and Motupalli^{43} in Andhra Pradesh along the east coast of India. The tradition of stamping the whole body of the pot (except neck and rim) was never prevalent in India, whereas it was widespread in China and Southeast Asia. Therefore, it is believed that the stamped ware found in the coastal sites might have been imported, probably from Southeast Asian countries or produced locally after learning technology. However, a comprehensive study is essential to draw conclusions. The date of stamped ware differs from site to site, for instance in Jau-gada, stamped ware was reported in association with punch-marked coins (PMC) datable to the 3rd and 2nd century BCE^{30}. In the case of Arikamedu the stamped ware was assigned to between 25 BCE and 25 CE. In Kottapattnam abundant quantity of stamped ware was found in sand deposits; therefore it is difficult to determine the period^{44} because this pottery also occurs in medieval context.

Across the Indian subcontinent, Roman amphorae of the Eastern and Western Mediterranean as well as the Red sea types were found from many sites of India, and mainly wine, olive oil and garum were transported in these vessels. Among amphorae types, Dressel 2–4 wine amphora (1st to 3rd century CE) and Amphore Egyptienne 3 (AE3) (1st century BC) were commonly reported from Arikamedu, Alagankulam Hathab and Pattanam, whereas AE3 was found only at Arikamedu and Pattanam^{45–48}. The other type of amphorae of the Mesopotamian origin without handles, barrel-shaped body, narrow base was known as torpedo jar, reported from many sites of India, but these torpedo jars have also been identified as Roman amphorae. In addition to amphorae, the terra sigillata, the fine moulded and decorated ware, which was imported from the Eastern and Western Mediterranean regions have also been found in Arikamedu, Alagankulam and Pattanam and many sites of southern and western India. The terra sigillata was brought to India as their personal belongings by the Roman traders, but not as an item supplied in trade^{49}. Other Roman artefacts imported to India were Roman glasses, glass vessels, lamps, mirrors, metal statuettes. Most of these Roman objects were discovered in northwestern, western and southern India.

Roman amphorae and Roman coinage are the most critical items for understanding the exchanges between the Roman empire and India. The Roman coins found in India have been dated more precisely by the name of the emperor and their reign period, and it has been agreed that the Roman contacts began under Augustus (31 BCE–14 CE) and continued up to the time of Nero, then it was revived in the 5th century CE. However, Turner^{50} urged that the Republican silver denarii arrived in India before Augustus and the Roman coins are the most prolific and largely studied along with other findings and 6000 denarii have been reported from South India. If one includes Late
Roman copper coinage, this number is substantially boosted with over 4000 from Karur and Madurai in Tamil Nadu\textsuperscript{51}. 

During Manikapatna excavations, a potsherd was found which has been identified as an amphora sherd\textsuperscript{52}. Similarly, one more sherd of an amphora was also found from Karanjari village, close to Jayarampur on the border of Odisha and West Bengal; it is now in a private collection\textsuperscript{53}. These finds are very few and it is not certain whether or not these are amphora sherds; therefore further studies are required to ascertain their origin and provenance. The Roman gold coins of Gordian, Constantine and other rulers were found at Bamanghati of Mayurbhanj, Odisha\textsuperscript{50,54}. Twenty-three gold coins were reported from Gumada in 1928 and sent to Madras Museum. Among the twenty-three gold coins of Gumada, only one coin appears to be the genuine coin of Septimius Severus\textsuperscript{50,55} and the remaining are considered counterfeited ones.

Similarly, four dinars, three of Augustus and one of Tiberius coins were found in undescribed circumstances from Kotapad of Odisha. All these eight coins are datable to the 1st century BCE–2nd century CE (Figure 5)\textsuperscript{50}. Except one, all other Roman coins of Odisha are imitated. Roman bullae (an amulet with Roman portraits worn around the neck like a locket) have also been recorded from the excavations of Sisupalgarh, Manikapatna and Radhanagar\textsuperscript{29,33,56}.

The above discoveries suggest that the Roman findings are limited in Odisha. Moreover, the authenticity of these findings should be understood unmistakably; whether these discoveries belong to the Roman period or not; and how did these findings come to Odisha? It is known that in ancient times trade was based on barter system and then coins were introduced. The local products were exchanged with both essential and luxury items at ports and trade/urban centres among the traders. In this context, the mariners of Odisha might have exchanged their products with locals as well as south Indian traders. But what kind of Roman artefacts were brought to Odisha for exchange is not known. As of now it is well known that the Roman objects found in Odisha are limited and insignificant and their authenticity needs to be studied further. The Roman findings such as amphorae, Roman coins, terra sigillata and other artefacts have been more abundantly recorded in Tamil Nadu, Andhra Pradesh, Maharashtra, Kerala and Gujarat in comparison with Odisha. Moreover, the Roman coins and amphorae sherd which are reported from Odisha need to be re-examined because the amphora sherd of Manikapatna (Figure 6) is a piece of a salt-glazed jar datable to the medieval period\textsuperscript{67} or could be a sherd of a mercury jar, but certainly not an amphora sherd. During the recent explorations of Khalkatapatna, a contemporary to Manikapatna port, a sherd of mercury jar found which is datable to the medieval period\textsuperscript{57}, even in shape and design these sherds resemble.

Even, the amphorae found in West Bengal are doubtful about their origin, it could be of West Asian origin datable to the early medieval period. The jars which are displayed as amphorae at the Tamralipti Museum are wrongly labelled. Similarly, the double handled jar\textsuperscript{58} of Karanjari village, nearer to Jayrampur of West Bengal (Figure 7) is also not an amphora. Amphorae like jars were found from Chandraketugarh, Tamralipti, Harinarayanpur and Atghara along with RW, which are not amphorae. None of the classical texts makes any direct reference to maritime contacts between the ports of Bengal coast and the Roman Empire, nor have any Roman coins been reported from the West Bengal coast. Therefore, the jars displayed at Tamralipti Museum and Karanjari village should be re-examined, and the Roman gold coins found at Bamanghati also need to be cross-examined. However, recently, an Aqaba (Aila-Axum) amphora was found in Kalindi village of East Medinipur district of West Bengal. It suggests the maritime contacts between Bengal coast and the Red Sea and the Mediterranean region during early medieval period\textsuperscript{59}.

![Figure 5. Roman coins used as ornament found from Gumada, Odisha. (Photograph: OIMSEAS, after Paula Turner\textsuperscript{50,514}.)](image1)

![Figure 6. Amphora sherd from Manikapatna. (Photograph: OIMSEAS.)](image2)
Roman mariners did not reach Odisha coast for trade and commerce because, except ivory, no other products of Odisha were required for the Romans. The Romans were more interested in Indian spices, textiles, silk, etc. Indian gemstones, spices, aromatic wood, sandalwood, silk, cotton, gems, ivory, textiles were in great demand in the Roman market. Moreover, Roman mariners directly reached the western and southern coasts of India crossing the Arabian Sea. The summer (Southwest) monsoon winds were favourable to sail up to the Indian coast. During this period, sailing vessels were more dependent on winds and currents which were seasonal. And sailing to Odisha beyond Tamil Nadu or Kerala coast would require longer time, probably which was not feasible for Roman mariners. Hence, it is believed that the merchandise of Odisha was transported to the southern and western coasts either by over land routes or by local mariners. Thus, it can be suggested that Odisha had probably indirect contacts with Romans.

Moreover, Periplus suggested that Roman ships did not sail up to the Odisha and Bengal coasts because of sailing schedules. It was proposed that ships from the Egyptian ports on the Red sea coast usually began their voyage for South Asia in July and reached South Indian ports in September and their return journey had to start in November with the aid of Northeast monsoon (trade) winds. The Roman merchants had very little time for selling their merchandise and loading ships with goods available from the local markets of Tamil Nadu or Kerala coast. Hence sailing down to Odisha or Bengal coast was difficult because it entailed the risk of missing the northeast trade winds. Furthermore, Roman mariners did not visit the Southeast Asian countries to get spices because of the time factor, but the spices of Southeast Asia were brought by the mariners of south India and the Romans collected them from Arikamedu. Moreover, Strabo (63 BCE–24 CE) stated that ‘the merchants of the present day, who sail from Egypt to India by the Nile and the Arabian Gulf, have seldom made a voyage as far as the Ganges’.

Periplus referred to the diamond of Sabarae which is identifiable nearer to Sambalpur and the ivory of Dosarene (perhaps refers to Odisha) which was considered the best Indian ivory. Both, the ivory and diamond were praised in Rome, these were luxury items, and their demand was less than spices. Further, Periplus suggests that the diamonds from India including Sabarae (Sambalpur) of Odisha was brought to Muzuris and Nelynda ports along the west coast of India from where it was exported to the Roman empire. It is not clear who were the traders bringing the diamond and ivory from Odisha to Muzuris and Nelynda. There could be possibilities that middlemen were involved in this trade or merchants of Odisha might have engaged in this activity.

It is not comprehensible, how the Roman coins, amphorae and other archaeological artefacts were found in Odisha? All these artefacts have been referred to as Roman period findings after their re-examination now it is proved that these are not amphora sherds.

With regard to direct maritime contacts between Odisha and the Roman Empire, no tangible evidence is available till date. But the materials from Odisha might have been carried away by the middlemen. However, future explorations and excavations may bring some new information which will enhance the knowledge and change the current state of understanding presented here; because very limited early historic sites of Odisha so far have been excavated. In the absence of direct and ample evidence, it is too early to corroborate that Odisha had direct contacts with Romans. Moreover, Periplus suggests that ships of the Red sea coast reached ports of South India in September and returned in November during the beginning of Northeast monsoon winds and they had limited time to visit other areas. This denotes that Roman traders could not directly go up to the Odisha and Bengal coasts. The Romans may have had no direct contacts with Odisha, but they were aware of ivory and diamond of Odisha. In all probability, some of the Romans might have visited Odisha or they were aware of the source and that is why Periplus mentioned about the quality ivory of Odisha which was highly praised. Precisely, it can be mentioned that so far no amphorae have been reported from Odisha and there were no direct maritime trade contacts between Odisha and the Romans during the early historical period. The counterfeit Roman coins were brought to Odisha to procure ivory as stated by Periplus or people of Odisha might have brought ivory to Muzuris and Nelynda and exchanged them for Roman coins. However, the authenticity of the coins should also be established. The present study provides an opportunity for future researches and debates on the maritime contacts between Odisha and the Roman empire.
Optimized culture conditions for enhanced recovery of exopolysaccharide from Pseudolagarobasidium acaciicola: a novel fungus isolated from the fruit body of Russula nigricans, a wild edible mushroom of Odisha, India

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Fungal exopolysaccharides (EPS) are becoming important due to their multifarious applications with different structural forms and easy recovery. The objective of this study was to optimize submerged culture condition of a new fungal isolate Pseudolagarobasidium acaciicola obtained from fruit body of an edible mushroom, Russula nigricans. The study analyzes the optimization of different parameters for enhanced production of EPS by one factor-at-a-time (OFAT) method. The influence of incubation period, initial pH value, temperature, mode of culture (static shake), culture vessel, carbon and nitrogen sources, and enhancers was studied. OFAT method revealed pH 6 with 7 days incubation statically and in dark in 150 ml Erlenmeyer flask, chemical factors like sabouraud dextrose HiVeg broth medium, xylose, yeast extract, tryptophan, K₂HPO₄, CaCl₂ and vitamin C as good conditions and components for maximum biomass and EPS production. Optimized medium developed in this study was a combination of the individually screened nutrient component, estimated the maximum EPS (1002.3 ± 189.72 mg/l) which was later expelled to 1468.1 ± 227.86 mg/l after addition of olive oil and Tween 80 at a concentration 250 : 50 μl/v, which was much higher, and reported first time from this fungus (it means that early when medium was formulated with different chemical components we got the optimized medium giving 1002.3 mg/l of EPS but when addition of oils was performed we got more amount, i.e. 1468.1 mg/l). EPS production in a new medium might facilitate its industrial-scale production and use as a bioactive product for the welfare of mankind.

**Keywords:** Exopolysaccharide, optimization, Pseudolagarobasidium acaciicola, submerged culture.

Many microbes produce bioactive polysaccharides which are high-molecular-weight polymers composed of long chains of monosaccharide units linked with glycosidic bonds and release the constituent monosaccharides/oligosaccharides on hydrolysis1–3. Polysaccharides are diversified due to their structure, properties, and

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