Conference Paper

Morphological and Anatomical Structure of Red Fruit (*Pandanus Conoideus* Lam.)

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Abstract

Red fruit *(Pandanus conoideus* Lam.) is one of the plant species in Pandanacea family. Moreover, it is also used as food, medicines, and dyes in Eastern part of Indonesia. For the local people in Papua, however, it is difficult to grow the red fruit using seed propagation due to the seed dormancy. In this study, we investigated the morphological and anatomical structure of the red fruit seeds. We conducted the study by observing the morphological and anatomical structure of the red fruit seeds and its seed dormancy. The study revealed that the red fruit drupe was divided into exocarp, mesocarp and endocarp layers. Anatomical analysis indicated that the seed coat consisted of parenchyma and lignin-walled cells. The inner layer of the seed coat was covered by mucilaginous, blockage and per carp. The endosperm consisted of starch containing parenchyma cells and small sized embryos that contained small parenchyma cells.

Keywords: Red Fruit, Drupe, Structure

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Received: 16 July 2016
Accepted: 14 August 2016
Published: 25 August 2016

Publishing services provided by Knowledge E

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Selection and Peer-review under the responsibility of the ICSBP Conference Committee.

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1. Introduction

Red fruit (*Pandanus conoideus* Lam.) is widely spread in Maluku, Papua and Papua New Guinea. Traditionally, the tribes in the interior of Maluku and Papua utilize the red fruit oil for sautéing vegetables and the sauce/paste for seasoning sweet potatoes and sago (Sadsoeitoeboen, 1999) as well as for dying (Sutarno, 2001). The fruit, in addition, can be used to treat number of diseases such as cancer, diabetes mellitus, rheumatoid, uric acid, asthma, high blood pressure, lung, heart disorders and kidney (Wiryanta, 2005).

For the local people in Papua, the propagation of red fruit seed was done by using vegetative buds (Sadsoeitoeboen, 1999; Makaruku 2008; Limbongan, 2009), since the seeds have low vigor and germination rate. Sadjad (1980) stated that the dormancy occured in the red fruit seed because of undifferentiated embryo. Additionally, the seed does not well germinate as a tissue that surrounds the embryo provides barriers (seed coat including the endosperm, pericrap or extrafloral organ) so that the embryo does can not grow (Bewley and Black 1994). Anonymous (2008) noted that the red fruit seed dormancy is caused by a hard seed coat. This condition prevents the absorption of water into the embryo and slows downthe seed growth. The embryos also have difficulty to penetrate the seed coat during germination process.

Tambunan (2005) found that red fruit seeds can germinate 0.6% after 34 days from the time of planting. Before planting the seeds were soaked in water 10^0C for 2 minutes and thus immersed in water at room temperature for 24 hours. However, the study found no endocarp layer structure, due to the difficulties of planting using the seeds. Therefore, it is necessary to study the morphological and anatomical structure of the fruit and seeds in order to get understanding of the red fruit seed germination.

2. Materials and Methods

The materials (the old and young red fruits) were taken from community garden in Mokwam Village, Minyambouw District in Manokwari Regency West Papua Province. The materials were selected from the best trees that free of pests, old enough and growth well. Thus, we put the materials in a plastic container and label edit. To do morphological and anatomical structure analysis, the fruit was squeezed and washed firstly. The old fruit were dried, while the young seeds were immersed in 70% ethanol. The fruit morphological analyses were analyzed based on the size, color, shape, and texture both the old and young seeds. The anatomical structure were observed microscopically using transverse and longitudinal slices of the fruits and dyed using phloroglucin and 25% HCL to detect wall cell lignifications.

3. Results

Result showed that *P. conoideus* Lam. fruit in the form of integrated compound (syncarp) was protected by a bract (braktea) (Figure 1a). Syncarp was red colour with a length of 86-110 cm and width around 30-35 cm (Figure 1b). Syncarp cylindrical was right triangular (Figure 1c) and consisted of many single fruits (drupe) with a length of 1-1.5 cm. The drupe was composed of 3 layers namely exocarp, mesocarp and endocarp enveloping the seed. In the mature drupe, fruit had exocarp that assembles red fruit flesh (Figure 1d). Layer of mesocarp was in the form of fiber (Figure 1e) and endocarp had hard coat like shell (Figure 1f). The top of the drupe was equipped with stigma (Figure 1g). Stigma is easily dislodged when the drupe has matured. Mesocarp pads are on the top cover drupe (Figure 1h and i) and the bottom of the drupe (Figure 1j and k).

Based on the presence of seed parts, the drupe was divided in to drupe with and without embryo (Figure 2a and Figure 2b). Drupe with embryo had a section consisting of seed coat, endosperm and embryo. While drupe seedless had only the seed coat, drupe with embryo when we cut crosswise, it tended to have a rounded shape (Figure 2c). In difference, drupe without embryo tended to have triangle, pentagon and hexagon forms (Figure 2d). The presence of drupe with embryo was found approximately 2% of 500 drupes used as sample.

Anatomical observation on the young and old drupe *P. conoideus* Lam. showed that there were many cells sklerenkim covered the seed. For instance, in the middle of the

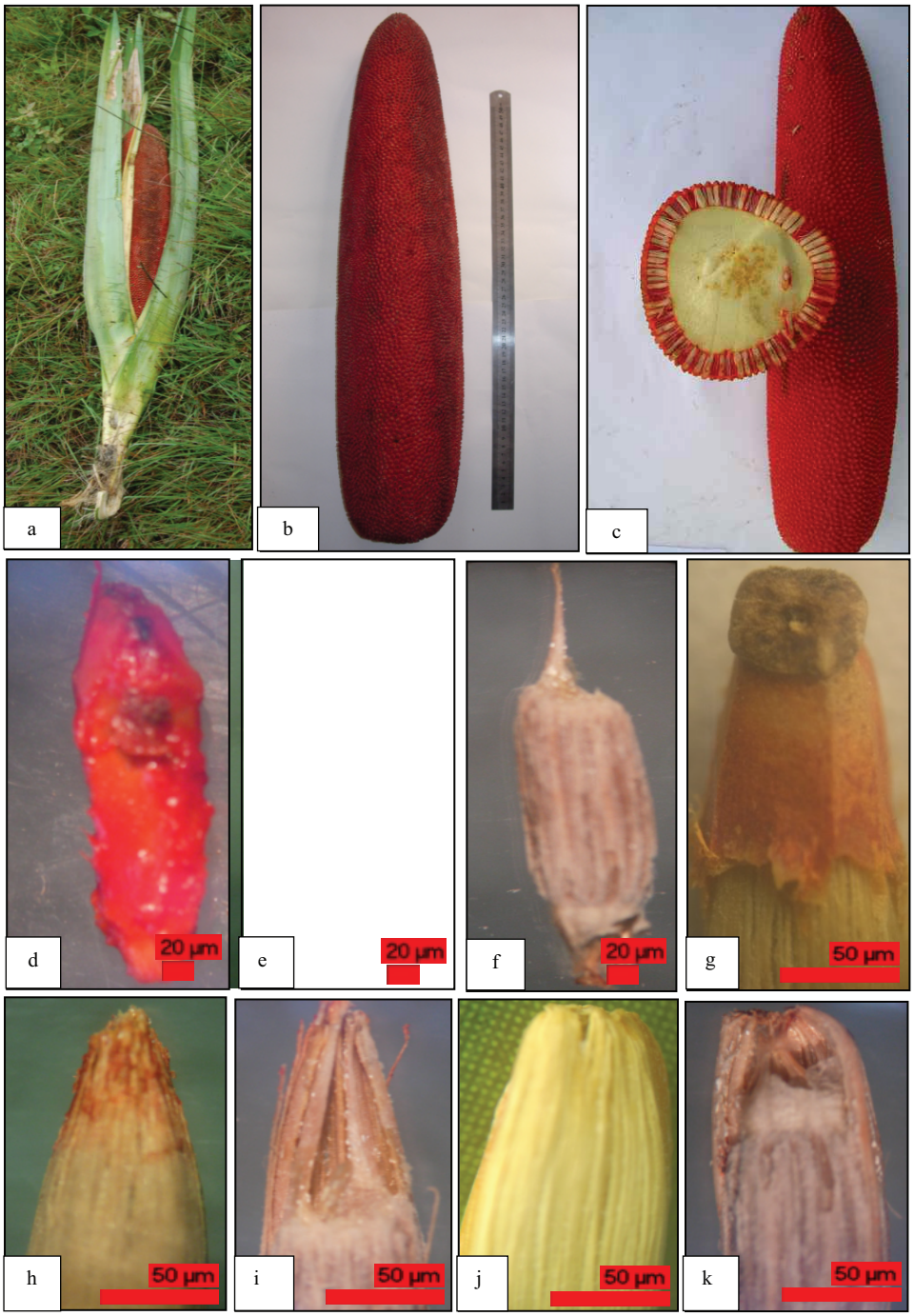

Figure 1: *P. conoideus* Lam. fruit (a) Syncarp with braktea (b) Syncarp (c) The middle of syncarp (d) Exocarp drupe (e) Mesocarp drupe (f) Endocarp drupe (g-i) The top (g) Drupe with stigma (h) Drupe without stigma (i) Drupe without mesocarp (j-k) The lower part (j) Drupe with mesocarp (k) Drupe without mesocarp.

young drupe, it showed exocarp, mesocarp and endocarp parts that enveloped the seed (Figure 3a-c). Exocarp contained parenchyma cells. The form of fiber in mesocarp consisted of parenchyma cells and vascular bundles with massive sclerencymatous. Vascular bundles were found in three circles. In the outer circle, it was found that location of the vascular bundles among each other were compact. The inner circle the inner circle, vascular bundles found stretchable. While, in the inner circle, in between

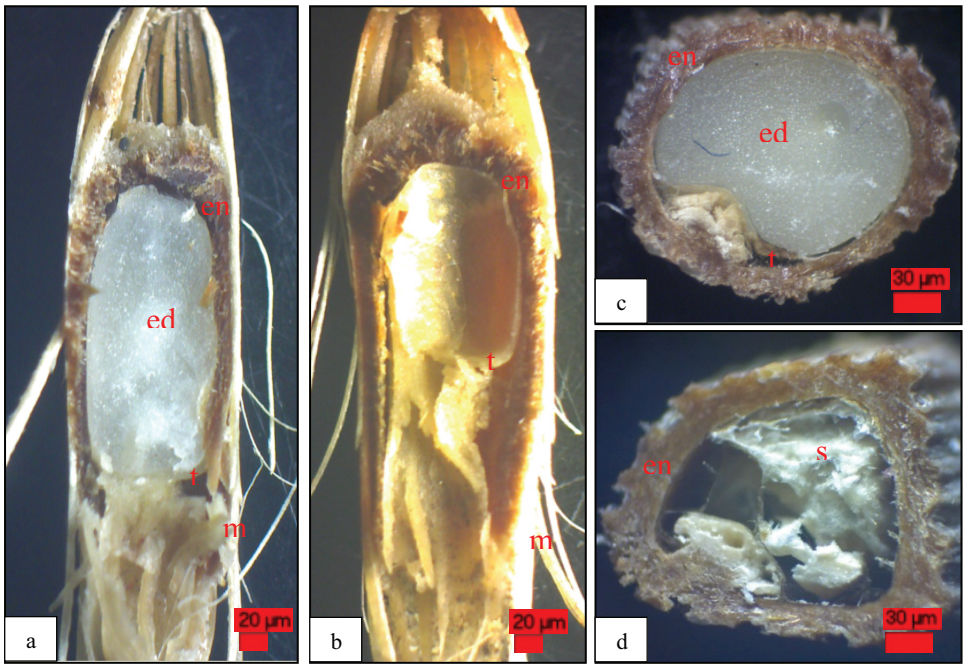

Figure 2: *P. conoideus* drupe (a,b) a cross-section sliced longitudinal of old drupe *P. conoideus* (c,d) a cross-section sliced transverse of old drupe *P. conoideus* (a,c) Drupe with embryos (b,d) Drupe without embryos. m: mesocarp, en: endocarp, t: seed coat, ed: endosperm, s: blockage.

vascular bundles. it contained fiber-like sclereids dense and irregular, which was part of the endocarp layer. Endocarp layer will harden when the fruit has matured (Figure 3d & e). The inside of endocarp found tissue, if it be watered formed mucus (mucilaginous). In the young drupe, we found many mucus. In addition, the inner endocarp, mucus is also found in large quantities in a special room at the top of the drupe.

P. *conoideus* Lam. seed consisted of the seed coat, endosperm and embryo (Figure 4 a). Seed coat was composed by parenchyma cells cube-shaped arranged in two layers (Figure 4b). In the outside of the seed coat, there were lignin cells increasing in number and they toward the embryo to form a blockage such as wings (Figure 4c). Endosperm contained of large cells and had thin walls that contained a lot of starch. Embryos were at the bottom of the drupe, covered by the blockage. Embryo was composed of small dense parenchyma cells (Figure 4d-e). Length embryo measured was 1/6 of the length seed (or smaller), while the width of the embryo was about 1/4 of the width seed.

4. Discussion

Essig (1977) reported that the vascular bundles with thin fibrous sheaths encountered vary in length and location. The vascular bundles with thin fibrous elongated sheaths and laid limited in mesocarp which was found in Normanbya and some species of *Veitchia*. Sheath fiber without vascular bundles (cordons fibreux) inmesocarp also can be found in some species, such as *Areca*, *Cocos*, *Clinostigma* and *Alliances*.The experiment done by Romanov et al. (2011) showed that the fifth and sixth stages of fruit development in the zone Borassus mesocarp consisted of parenchyma cells containing

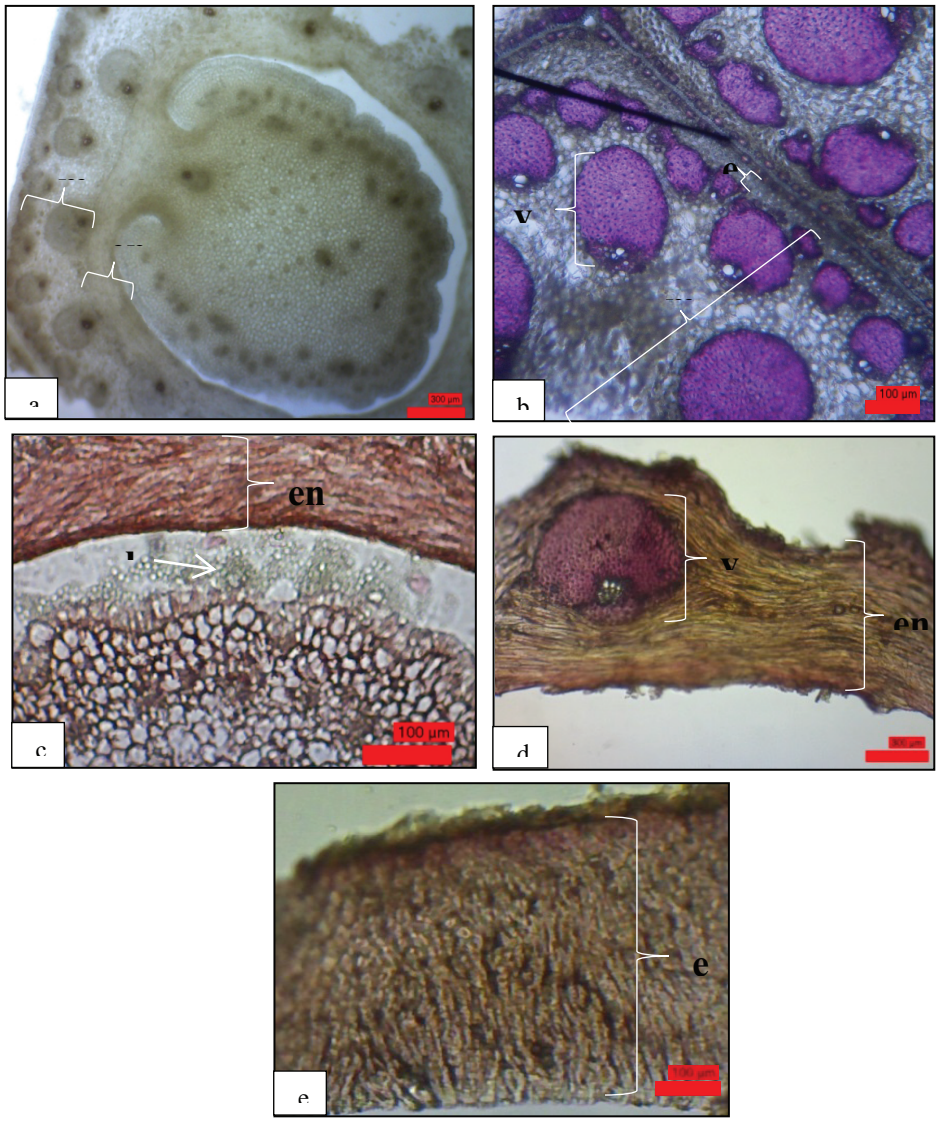

Figure 3: Cross-section of *P. conoideus* Lam. drupe (a-c) cross-section of young drupe (d) cross-section of old drupe (e) cross-section longitudinal on old drupe. ex: exocarp, m: mesocarp, en: endocarp, vb: vascular bundles cells enveloped sklerenkim, l: mucus.

tannin with thickened walls, fiber-like sclerosis with walls lignified and many vascular bundles with massive sclerencymatous.

Mucus is a matrix that contains pectin in the cell wall will be inflated when it is put in to water. Such cell walls are composed of galacturonic acid not in large numbers with the ability of hydration. The mucus either may or may not contain cellulose microfibrils. In *Linum usitatissimun* seeds, there is an outer layer of mucus when exposed to water (Fahn, 1995). Martin (1946) classified the embryos in three main types: basal, peripheral and axile. *P. conoideus* Lam. embryo can be categorized into basal-type embryo. Basal type is characterized by the larger size of endosperm and the small embryo. The embryos shape globular until the oval-oblong. While, cotyledon is usually not perfect and clear, but it can sometimes be seen. The size of seeds ranges frommediumto large

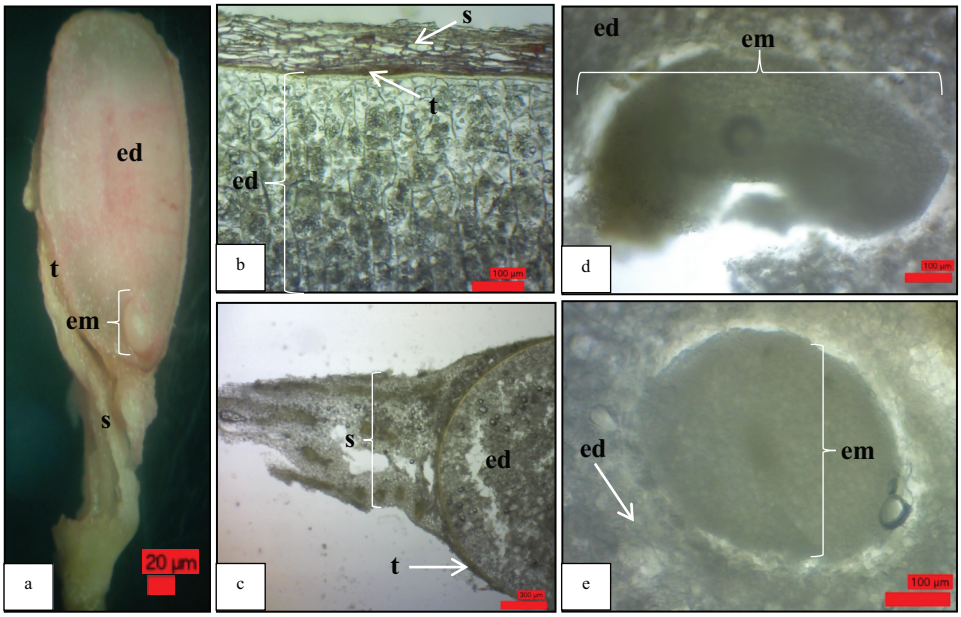

Figure 4: *P. conoideus* Lam. seed (a) Cross-section longitudinal seed (b) The structure of seed coat and endosperm (c) Cross-section of the blockage (d) cross-section longitudinal of the embryo (e) Cross section of the embryo. ed: endosperm, t: seed coat, em: embryo, s: blockage.

size. The basal type embryos can be also found in *Magnolia* spp., *Anemone* spp. and *Trollius* spp seeds.

5. Conclusions

Red fruit seeds consist of seed coat, endo sperm and embryo. Embryoof red fruit seeds were small and surrounded by a thick endosperm. The thin of red fruit seeds coat surrounded by a blockage, mucilaginous and fruit pericarp.

References

[1] A. VF. Bobrov, 2008, Red Fruit. CV Bali Spot Internasional Co. Ltd., Diakses Maret, 2012 www.buah-merah.info, (2012).

[2] J. D. Bewley and M. Black, *Seeds: Physiology of Development and Germination*, Plenum Press, New York, 1994.

[3] A. V. F. Bobrov, D. H. Lorence, M. S. Romanov, and E. S. Romanova, Fruit Development and Pericarp Structure in Nypa fruticans Wurmb (Arecaceae): A Comparison With Other Palms, *Int J Plant Sci*, **173**, 751–766, (2012).

[4] F. Essig, A Systematic Histological Study of Palm Fruit I, The Ptychosperma alliance, *Syst Bot*, **2**, 151–168, (1977).

[5] A. Fahn, *Plant Anatomy*, Gadjah Mada University Press, 1995.

[6] L. Limbongan and A. Malik, Development Opportunities of Red Fruit (Pandanus conoideus Lam.) in Papua Province, *Jurnal Litbang Pertanian*, **28**, 135–141, (2009).

[7] M. Makaruku

[8] A. C. Martin, The Comparative Internal Morphology of Seeds, *Am Midl Nat*, **36**, 513–660, (1946).

[9] M. S. Romanov, A. V. Bobrov, D. SA. Wijesundara, and E. S. Romanova, Pericarp development and fruit structure in borassoid palms (Arecaceae-Coryphoideae-Borasseae), *Ann Bot (Lond)*, **108**, 1489–1502, (2011).

[10] S. Sadjad, *Development Guide Plant Seed Quality of Forestry in Indonesia*, Forestry Seeding Center Project Reforestation and Rehabilitation Directorate General Directorate of Forestry, 1980.

[11] M. J. Sadsoeitoeboen, Pandanaceae: Aspects of Botany and Ethnobotany in the Life Tribe Arfak in Irian Jaya. Unpublished data (1999).

[12] S. Sutarno, Plants Producing Natural Color and Utilization of the Life Tribe Meyah in the Village Yoom Nuni Manokwari, Unpublished data (2001).

[13] R. Z. Tambunan, Soaking Test Effect in Different Water Temperature on Germination of Red Fruit Seed length (Pandanus conoideus Lam.), Unpublished data (2005).

[14] B. T. W. Wiryanta, *Potency and Benefits of Red Fruit*, Agromedia, Jakarta, 2005.