Rev. Biol. Trop., 33(1): 67-69, 1985

Metabolism of the seed of *Adansonia digitata* L.

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(Received for publication July 3, 1984)

Resumen: Las semillas de *Adansonia digitata* contienen sacarosa, almidones, proteínas, y lípidos en sus reservas alimenticias. La sacarosa es el único azúcar soluble en etanol; el contenido de lípidos es muy alto, de ahí la tendencia de clasificarlas como "semillas oleaginosas". Las reservas alimenticias disminuyen durante las dos primeras semanas después de germinar, debido a la hidrólisis por las enzimas, reflejando un aumento en la actividad de invertasa y de lipasa.

Adansonia digitata L. is a member of the family Bombacaceae. Although this species is widely distributed in the drier parts of Nigeria where savanna vegetation abounds, its population density in the field is very low (Etejere and Osatimehin, 1984). Apart from studies on the economic importance of this plant (Palgrave, 1977; Weiss, 1979; Etejere and Osatimehin, 1984) there is very little research on aspects of its physiology.

Laboratory analyses of the seeds, 1, 2, 3 and 4-week old seedlings were performed by various standard procedures to determine qualitatively and quantitatively the ethanol-soluble sugars, total starch, proteins, lipids, and amino-acids. Invertase and lipase activities were also determined to give an idea of the type of metabolism occuring in the seeds and seedlings.

The results showed that seeds of *A. digitata* contained sucrose as the only ethanol-soluble sugar (Table 1). Two-week old seedlings contained, sucrose, fructose, glucose and maltose. Mannose was also detected in 3 and 4-week old seedlings.

Quantitatively sucrose content in the seeds and 1-week old seedlings were 5.81 and 1.39 mg g^{-1} dry weight of sample respectively (Table 1). Glucose was the main sugar in 2- and 4-week old seedlings while maltose had the highest representation in 2- and 3-week old seedlings (Table 1). The starch content decreased from 2.63 to 0.55 mg g^{-1} dry weight during the early stages of seedling development (Table 1). The total protein decreased during germination and growth of the seedlings. The seeds contain an abundance of lipids (Table 1). The lipid content decreased gradually from 28.2 mg in 1-week old seedlings to 17.7 mg g^{-1} dry weight of sample in 4-week old seedlings. The total amino acids was lowest in the seeds (0.056 mg g^{-1} dry wt of sample) when compared with the contents of the seedlings. The highest quantity of 0.27 mg g^{-1} dry wt of sample occured in 4-week old seedlings.

Invertase activity in the seedlings increased during the first 2 weeks of growth and thereafter decreased in the third week (Fig. 1). The highest activity was observed in the second week of growth. Lipase activity also increased significantly with seedling age during the first two weeks of growth but decreased thereafter (Fig. 2). The period of highest activity was during the second week of growth.

The data show that *A. digitata* contains major food reserves for the resumption of growth of the embryo when environmental conditions become favourable. These include carbohydrates, proteins and lipids with lipids being the highest. Dalziel (1965) reported that the major food reserves in *A. digitata* seeds are lipids. The lipid content in the seeds decreased sharply during germination and subsequent growth of the seedlings. This is evidence that the lipids were being converted into fatty acids and glycerol by lipase. It is therefore not unlikely that these products are then transported to the growing regions where they are utilised to supply energy for growth. Goodwin

TABLE 1

Changes in the food reserves during germination of A. digitata seeds.
Food reserves are expressed as mg g^{-1} dryweight of sample

(S.E. values are given)

Food reserve	Resting Seeds	Age of seedlings 1 wk	2 wk	3 wk	4 wk
Glucose	–	3.54 ± 0.04	4.45 ± 0.04	3.40 ± 0.01	3.71 ± 0.03
Fructose	–	2.07 ± 0.06	2.76 ± 0.02	1.90 ± 0.03	2.21 ± 0.07
Sucrose	5.81 ± 0.05	1.39 ± 0.03	2.84 ± 0.09	4.53 ± 0.03	4.223 ± 0.05
Maltose	–	4.09 ± 0.07	4.31 ± 0.01	4.13 ± 0.04	3.29 ± 0.03
Mannose	–	–	–	2.50 ± 0.02	2.86 ± 0.03
Starch	2.63 ± 0.01	0.55 ± 0.03	5.23 ± 0.01	10.80 ± 0.15	11.22 ± 0.16
Amino Acid Pool	0.06 ± 0.0	0.08 ± 0.0	0.22 ± 0.0	0.23 ± 0.0	0.27 ± 0.0
Proteins	3.58 ± 0.04	2.2 ± 0.12	1.64 ± 0.02	1.20 ± 0.06	1.36 ± 0.02
Lipids	32.40 ± 1.18	28.20 ± 1.12	22.20 ± 1.15	18.19 ± 0.94	17.73 ± 0.92

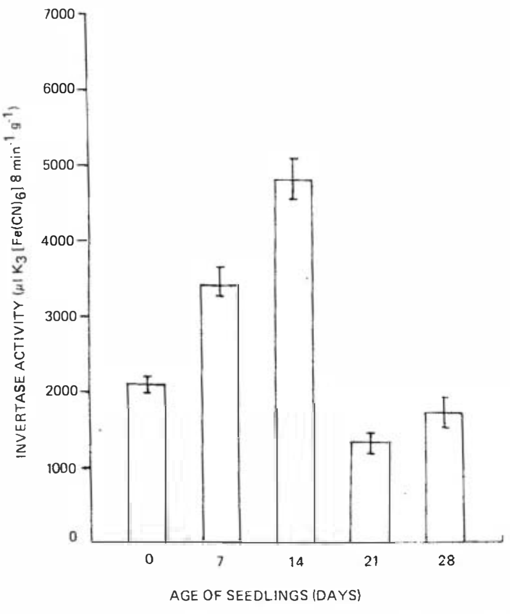

Fig. 1. Activity of invertase in seeds and seedlings of *A. digitata.* Enzyme activity was expressed as µl potassium ferricyanide reduced 8min^{-1} reaction time g^{-1} sample.

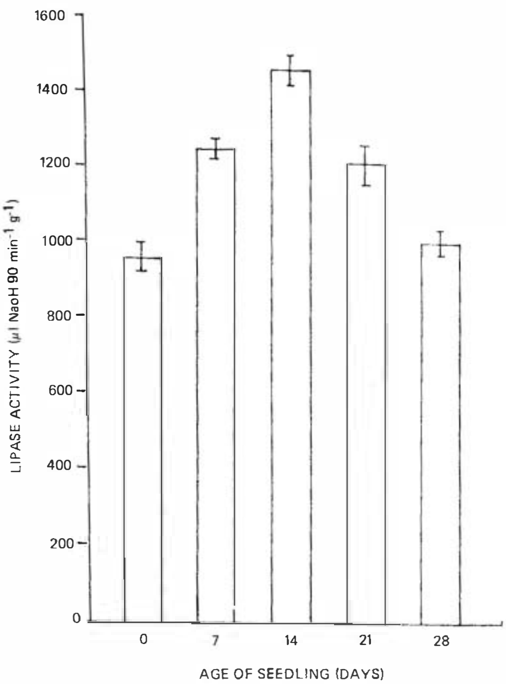

Fig. 2. Activity of lipase in seeds and seedlings of *A. digitata* Enzyme activity was expressed as µl NNaoH required to neutralise the free fatty acids 90min^{-1} incubation time g^{-1} sample.

and Mercer (1972) reported that fatty acids are activated by conversion into Acyl-Co-A derivatives by a microsomal enzyme and later converted by soluble enzymes into Acetyl Co-A. When the acetyl Co-A is fed into the glyoxylate cycle it is converted into sucrose. The key enzymes in these conversions are isocitratase and malate synthetase.

This study has shown that *A. digitata* seeds and growing seedlings are equipped with the necessary food reserves for a healthy and rapid growth. The low population density of this species in the field could thus be attributed to dormancy caused by the seed coat (Etejere and

Osatimehin, 1984) and the annual savanna bush fires which burn off the young seedlings. Since the seed coat dormancy can be terminated by acid scarification (Etejere and Osatimehin, 1984), perhaps raising of the young seddlings in nurseries and adequate protection from environmental hazards after transplant in the field would enhance population density and distribution of the species.

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