



**UNIVERSITI PUTRA MALAYSIA**

**PROLINE ACCUMULATION IN OIL PALM  
POLYEMBRYOGENIC CULTURES  
UNDER VARIOUS CONDITIONS**

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**PROLINE ACCUMULATION IN OIL PALM  
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UNDER VARIOUS CONDITIONS**

By

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IN THE NAME OF ALLAH, MOST GRACIOUS, MOST MERCIFUL

Dedicated To:

My Wife : Rabiah Abdul Wahid

My Sons : Hasan Al-Basri

: Muhammad Yazid

: Ahmad `Ulwan

: Ahmad Abrar

: Muhammad Hanif

My Parents : Hashim and Rabiah

My Brothers and Sisters

My Teachers and Friends.....



Tidak suatu bencana pun yang menimpa di bumi dan (tidak pula) pada dirimu sendiri melainkan telah ditulis di dalam kitab (Lauhul Mahfuzh) sebelum kami menciptakannya. Sesungguhnya yang demikian itu adalah mudah bagi ALLAH. Kami jelaskan yang demikian itu supaya jangan kamu berdukacita terhadap apa yang luput dari kamu dan supaya kamu jangan terlalu gembira terhadap apa yang diberikanNya kepadamu. Dan ALLAH tidak menyukai setiap orang yang sombong lagi membangga diri

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## LIST OF ABBREVIATIONS

The following abbreviations were used in the text:

|     |                                  |
|-----|----------------------------------|
| ABA | Abscisic acid                    |
| AOA | Amino-oxyacetic acid             |
| ARG | Arginine                         |
| GLN | Glutamine                        |
| GLU | Glutamic acid                    |
| GSA | Glutamic- $\gamma$ -semialdehyde |
| IBA | Indolebutyric acid               |
| MS  | Murashige and Skoog<br>(1962)    |
| ORN | Ornithine                        |
| OT  | Ornithine aminotrans-<br>ferase  |
| P5C | Pyrroline-5-carboxylic<br>acid   |
| PE  | Polyembryogenic                  |
| PRO | Proline                          |
| RNA | Ribonucleic Acid                 |
| SEM | Standard Error of the<br>Mean    |
| T4C | Thioprolin                       |



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Low temperature of 15°C to 20°C was observed to suppress the growth and multiplication capacity of oil palm polyembryogenic cultures. This condition enabled the cultures to be maintained for at least six months duration without subculture and thus was suitable for minimal growth storage of in vitro cultures.

Proline, a universal stress indicator, was found to accumulate in oil palm cultures under low temperature and moisture stresses (sucrose treatment) but not under anaerobic stress (non-agitated liquid media treatment). Sucrose treatment at 0.5 M caused moisture reduction and induced proline accumulation. In addition, when combined with low



temperature storage it extended the low temperature tolerance and prolonged the subculture duration for at least nine months.

The application of exogenous proline and ornithine at 10 mM could also induce proline accumulation in the cultures. However, only low level of proline accumulated with application of glutamic acid, glutamine and arginine. Inconsistent pattern was observed with pyrroline-5-carboxylic acid (P5C). P5C reductase (EC 1.5.1.2) and ornithine aminotransferase (EC 2.6.1.13) were found to involve directly/indirectly with proline biosynthesis in polyembryogenic cultures. The specific activities of these enzymes and soluble protein were higher under low temperature and moisture stresses. Since exogenous ornithine could induce proline accumulation and there was an active involvement of ornithine aminotransferase, ornithine could be one of the preferred precursors for proline biosynthesis in oil palm cultures.

Similarly, Thioproline (proline analog) increased proline accumulation but produced some toxic effect which eventually killed the cultures. Polyembryogenic cultures were found to utilize the exogenous proline and ornithine more efficiently in the liquid media than in the solid media. The proline in accumulated cultures which were treated with exogenous proline, ornithine and subjected to low temperature





stress was observed to return to normal level on transferring to the normal media and conditions. This suggested that the proline accumulated was readily utilizable when returned to normal conditions and could be considered as a labile metabolite in oil palm polyembryogenic cultures.

