

5. The Role of In Vitro Culture Methods of *Cammelia sinensis* L. Plants in the Global Society Transformation

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The Role of *In Vitro* Culture Methods of *Cammelia sinensis* L. Plants in the Global Society Transformation

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Abstract

The purpose of this paper is to explore the role of *Cammelia sinensis* L in vitro culture in the transformation of a global society with all its changes, both in positive terms and weaknesses. What makes this study relevant to this goal is the transformation of the global society, besides obtaining benefits, it also raises various problems. Problems that arise include the explosion of the world population due to climate change, the threat of malnutrition, the emergence of obesity disorders, disruption of agricultural production and chaos or the high cost of transportation whether by land, sea, or air. The method used is examining the literature on the role of *in vitro* culture in global social transformation related to climate change, health, agriculture, and transportation. The results obtained from the study of the role of *in vitro* culture in this global society transformation include obtaining some seeds with certain clones that are resistant to climate change so that nutritional deficiencies can be anticipated, secondary metabolites obtained from *Cammelia sinensis* L can be applied to reduce obesity. And *in vitro* culture can facilitate transportation because of the packaging form model from practical-efficient. This study concludes that the *in vitro* culture method of *Cammelia sinensis* L is very important in reducing problems in the global society transformation.

Keywords: *Cammelia sinensis* L, implementation of *in vitro* culture, secondary metabolites, high competitive product.

Introduction

Camellia sinensis L has a high economic value and its metabolite content is useful in various industries. In the food industry, it is useful for natural dyes (Shahabi et al., 2014) as well as drinks that are effective for increasing concentration (Yamada et al., 2009) users. The majority of tea drinks are favored by most international communities such as in Asia, Europe, and America (Grigg et al., 2003). The leaves of the *Camellia sinensis* L plant from Indonesia which are made for beverage ingredients are very popular with the majority of people from the United Kingdom. Although the *Camellia sinensis* L crop is favored and often exported to the United Kingdom, its productivity is still very low because most of the plants are old (Sriyadi et al., 2012). While the transformation of global society got its benefits, it also raises various

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problems. Problems that arise include population explosion, climate change, health problems, disruption of agricultural production, high costs of transportation, and the development of sustainable transportation. The impacts of climate change disruption related to agriculture include a decrease in the production of corn, sorghum, and rice by 7-13 in the republic of Tanzania (Rowhani et al., 2011). The problem of population explosion is relevant to the condition of malnutrition in society (Menon et al., 2016). Health problems such as infectious diseases and metabolic disorders such as obesity (Ira, 2012). The problem of high transportation costs, whether by land, sea or air, requires the development of sustainable transportation (Munawar, 2007). The role of *in vitro* culture of transformation in this global society obtained seeds with certain clones that are resistant to climate change so that nutritional deficiencies can be anticipated, secondary metabolites obtained from *Cammelia sinensis L* that can be applied to reduce obesity (Qi et al., 2013) and *in vitro* culture can facilitate the transportation because of the packaging form model from *in vitro* culture that is practical-efficient in storage (Mukhopadhyay et al., 2015). The purpose of this paper is to explore the role of *in vitro* culture in general and *in vitro* culture in *Cammelia sinensis L* in the transformation of a global society with all its changes both in positive and negative aspects.

Research Method

The methodology used is examining the literature related to *in vitro* culture, the content of secondary metabolites *in vitro* culture, and the role of *in vitro* culture in global social transformation related to climate change, health, agriculture, and transportation. The results and discussion regarding the role of *in vitro* culture in general and *in vitro* culture in *Cammelia sinensis* in global social transformation, the study is listed in the following results and discussion.

Result and Discussion

The results of the study from the role of *in vitro* culture in this global society transformation obtained information, they are about: (1) *in vitro* culture technology in *Cammelia sinensis L*. plants (2) Secondary metabolites *in vitro Camellia sinensis L* cultures. (3) The role of *in vitro* culture in global social transformation is related to climate change. (4) The role of *in vitro* culture in global social transformation related to health. (5) The role of *in vitro* culture in global social transformation related to agriculture. (6) The role of *in vitro* culture in global social transformation related to transportation.

In vitro culture technology in Cammelia sinensis L

In vitro culture technology in *Cammelia sinensis L* is a technology that is completely controlled in an aseptic environment that makes plants can grow or produce biomass that can be harvested in a relatively short time. This technique can be an alternative solution in various fields of industry. The *in vitro* culture technique consists of five stages (Hina et al., 2012) which are partially modified. The first stage is sterilization of equipment, rooms, materials used, and plant materials as explants for basic materials. The second step is to get a callus by initiating a sterile explant of tea leaves in a room/cabinet called a laminar airflow cabinet. The third stage is to seek cell differentiation so that the callus reproduces itself in a conditioned medium (Sutini, 2009). The fourth step is accelerating the acquisition of callus biomass by providing precursor techniques or elicitor as well as monitoring the biosynthetic pathway. The fifth stage is the identification or extraction of secondary metabolites that are formed to be applied according to the needs. (Mediana, 2018; Maalik et al., 2014).

Secondary Metabolites in *in vitro* Culture of *Camellia Sinensis L*

Secondary metabolites *in vitro* Culture of *Camellia sinensis L* include compounds such as catechin gallate, quercetin, myricetin glycoside, epigallocatechin gallate, and glycosides (Zhang et al., 2017). Research conducted by Sutini et al. (2017) have succeeded in getting the secondary metabolite Trimethyl xanthina from the extract of *in vitro* Culture in *Camellia sinensis L*. The same thing was done by other researchers and obtained catechins from the cultivated tea plant Yunnanshilixiang (Zhi et al., 2014). Some secondary metabolites in the form of essential oils are also found including monoterpenic hydrocarbons, oxygenated monoterpenes, and sesquiterpenes (Saima et al., 2008).

The role of in vitro culture in global social transformation related to climate change.

The role of *in vitro* culture related to climate change from this study as shown in Table 1, including the application of bioreactors for production, increased embryogenesis, disease-resistant plants, low-temperature resistant plants/low-temperature climate.

Table 1. Role of *in vitro* culture related to climate change

Form of culture	Secondary metabolites	Function	Reference
Callus-suspension	Citrus	Semi-solid bioreactor	Javier et al. (2019)
Plant tissue culture	Crop Species	Embryogenesis enhancement	Kumar et al. (2019)
Plant Tissue Culture	Plant Tissue Culture	Resistance to disease	Ali and Syandan (2018)
Plant Tissue Culture	Plant Tissue Culture	The response to cold treatment	Kenta et al. (2016)

The role of in vitro culture in global social transformation related to agriculture

The role of *in vitro* culture in global social transformation related to agriculture includes some functions such as: ornamental plants, somaclonal variation, allelochemicals, micropropagation, natural dyes, Herbicidal, pesticides are mentioned in Table 3.

Table 3. The role of *in vitro* culture in global social transformation related to agriculture

Form of culture	Secondary metabolites	Function	Reference
Callus	Quercetin	Ornamental plants	Acemi et al. (2018)
Callus	Callus	somaclonal variation	Korkmaz and Cölgeçen (2013)
suspension	Canavanine	allelochemical	Sasamoto et al. (2019)
Callus	Micropropagation	micropropagatio	Débora et al. (2019)
Callus	Micropropagation	norbixin natural dyes	Daniele et al. (2019)
Callus	(Musa AAA cv. Grand Naine	micropropagation	Jericó et al. (2019)
Hairy root,	Phenolic	Herbicidal activity	Uddin et al. (2012)

Plant Tissue Culture	Plant Tissue Culture	reduction of pesticides	Rolando et al. (2010)
Callus	Phenolic	anti planthopper / <i>empasca</i> SP. (<i>Homoptera</i> : <i>Cicadellidae</i>)	(Saiful and Sudarsono 2013)

The role of in vitro culture in global social transformation related to transportation

The role of in vitro culture in global social transformation related to transportation is the application of semi-solid bioreactors, simple packaging, so that it is lightweight in the financing, producing better quality of flavors, as shown in Table 4.

Table 4. The role of *in vitro* culture in global social transformation related to transportation

Form of culture	Secondary metabolites	Function	Reference
Callus-suspension harvested	citrus anthocyanin	semi-solid bioreactors pericarp browning	Javier et al. (2019) Yang et al. (2011)
Plant Tissue Culture	Plant Tissue Culture	Low-cost options	Ahloowalia and Prakash (2002)

Conclusion

This research concludes that the in vitro culture method of *Cammelia sinensis* L is very instrumental in reducing problems in global social transformation including related to some improvement such as health, agriculture, sustainable transportation, and anticipation of climate change.

Suggestion

This research concludes that the in vitro culture method of *Cammelia sinensis* L is very instrumental in reducing problems in global social transformation including related to some improvement such as health, agriculture, sustainable transportation, and anticipation of climate change.

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