Advances in application of dromedary camel tissue culture research

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Abstract

The dromedary camels have a great economic value in Asia and Africa, where they are kept for production of milk, meat, wool and leather; they are also used for transportation in some areas. Recently, the camel racing practice in the Middle East has added to the cultural value of dromedary camels, which lead to increased interest in improving their genetic makeup, reproductivity and treatment efficiency. Tissue culture-based therapy in domestic animals is described as safe with considerable welfares to the animals. Tissue culture application is currently growing in the fields of vaccine production, virus cultivation and study, cancer research, gene therapy, Immunological studies and molecular biology. In veterinary medicine tissue culture technique has been used for the study of viral infection dynamics and vaccine development and for treatment of many affectation including musculoskeletal system injuries, liver disease and mastitis. However, in dromedary camels such applications are relatively less. The current work reviewed the available research on tissue culture in dromedary camels. Our review shed light on the therapeutic, genetic, preventive and reproductive contribution of tissue culture application in dromedary camels.

Key words:
Dromedary camel, Tissue culture.

1. Tissue and cell culture

It has been established that tissue or cell culture refers to a method by which fragments of tissue or cells taken from an animal are kept alive into a new artificial environment, where they might differentiate and their function architecture are preserved [1-2]. Tissue culture technique made it possible for new specialized cells and tissues to be maintained, and thus the possibility to address many important biological problems in new ways [5]. According to the latter authors cell culture can be classified as primary cell culture (cells are obtained from a host tissue) and secondary cell culture (cells obtained from primary culture are sub-cultured to form cell lines). It has earlier been mentioned that cell banks are of extreme importance in mammalian species preservation [6] by reserving their cells, tissues, semen, embryos, cDNA libraries and genomic libraries. At the cell bank somatic cell line is produced and saved by cryopreservation method [7]. The use of cell lines in research could overcome the limitations of animal experiments and provide a viable, practical and timely genetic material backup. Additionally, cell lines are considered as a versatile tool for animal cloning studies in the fields of virology, toxicology, and epidemiology. Cell lines could perform finite or infinite divisions.

Cell culture application has been investigated in many fields including pharmacology, medicine, reproduction, stem cell therapy and regenerative medicine [8]. Stem cell application is a branch field of tissue culture research, which provides promising issues, both in vitro and in vivo in animals, and also rendering speculation regarding its future therapeutic and preventive applications in human [9-11]. Stem cells have been described as un-specialized cells, which have the ability to renew, and if correctly stimulated, they can differentiate into specialized cells [12]. They have been classified into two types: embryonic stem cells (obtained from inner-cell mass...
of the blastula of developing embryos) and adult stem cells (obtained from different adult tissues) [13].

2. Tissue Culture application in veterinary medicine

In domestic animals stem cell therapy has been reported in some studies noting that the process is safe giving considerable futures to animals treated [14]. Thus, many clinics are nowadays using autologous or allogenic stem cell injection in fresh or cultured forms in their laboratory in treatment of various veterinary diseases. In addition to direct clinical stem cell application, a number of animal models have also been tested for these purposes [15]. This included treatment of tendons, bones and cartilage injuries in horse [16-18], cardiac diseases in dog [10, 14, 19], rodents and canine nervous system injuries [20-25], liver injuries in lab animals [26—29], wound in ruminants [30-31] and mastitis [15,32].

3. Tissue culture application in dromedary camels

The dromedary camel is the main food supplier in the desert regions as it is highly adaptable to the desert harsh environment [33]. Traditionally, camels are also used in racing in the Arabian Gulf countries which results in injuries of many valuable camels [34]. Therefore, development of research regarding tissue regeneration techniques has become highly demanded.

3.1. Stem cells

Studies on dromedary camel stem cells are rare in the literature reviewed and this field seems to be its early stages. Adipose-derived stromal cell frequencies and growth characteristics have been isolated and studied in camel [35]; their osteogenic, chondrogenic and adipogenic differentiation potentials have been assessed concluding that as in human, camel adipocytes also contain multi-potent cells and many of them represent an important source of stem cells, both for preclinical studies and veterinary cell therapy.

Skin fibroblast cell line called “DUBCA” has earlier been established and characterized in dromedary camels [36]; however, that line has not been labelled. Furthermore, generating camel fibroblast cell lines that express green fluorescent protein (GFP) would be important as a tool to monitor camel cell growth, migration and other processes [37]; transfection of GFP into the Arabian camel skin and lung fibroblasts did not change their observed properties. Thus, GFP-labelled cell lines may represent a new tool for convenient monitoring of live primary camel fibroblasts. Arabian camel skin fibroblast cell line (SACAS) was also used in the expression of small heat shock proteinbeta-1(HSPB-1) from in dromedary camel [38]. Recently, various differentiated cells have been isolated from the dromedary camel dermis including fibroblasts and keratinocytes, cyst-forming cells, as well as multipotent dermal stem cells [39]. Those stem cells are capable of forming spheres that form osteoblasts, neurons and adiposities. Therefore, dermal stem cells constitute a reservoir for skin repair elements in camel which could be involved physiologically and pathologically in tissue repair. Further studies are essentially needed to isolate and propagate different skin.

Embryonic stem cells (ESCs) are known as pluripotent cells which have the ability to differentiate into all types of tissue and cells comprising the animal and human tissues, such as liver, muscle, brain, cartilage and bone tissues. ESCs originate from the embryonic inner cell mass (ICM) at early of blastula stage; they give rise to the three germ layers: the endoderm, mesoderm and ectoderm, from which originate the different tissues of the animal body [40]. The ovarian cumulus cells from dromedary camels has been obtained for the first time in 2018 [41] showing that cumulus of camel can express stem cell mRNA transcript (PO5A1, KLF4, SOX2 and MYC) and are able to differentiate giving other non-ovarian follicular cells in vitro like osteoblast, neurons and adipose cells. Similarly, embryonic stem like cells have recently been isolated from dromedary camel embryo [42] which is considered highly promising for biomedical research, genetic engineering and early developmental biology. Embryonic stem cells (ESCs) and trophectoderm stem cells have been isolated from camel embryos for the first time on feeder-free conditions and showing the expression of all pluripotency genes (Sox2,Oct4, and Myc, Klf4) in the established cell lines through the conventional and real-time relative quantitative polymerase chain reactions [42]. Those isolated ESCs were differentiated into neuron-like cells successfully. Differential expression of certain genes such as Klf4 was also found; it presented significant increase in tropheoblasts as compared to the ESCs; this raises the question as to whether Klf4 or other transcripts are essential for pluripotency in camels. Consequently,
the whole gene sequences responsible for the pluripotency have been sequence and identified in camels and these genes have also been cloned to be easily used to transform differentiated somatic cells into pluripotent stem cells after transfection of the cells with pluripotency transcription factors.

3.2. Cloning

Cloning holds the promise of allowing creation of genetically superior or engineered animals in one generation [43]. Clonal samples of genetic material, especially the skin cells from unique animals, may be very important for conservation of the available genetic diversity of threatened animal genetic resources [44, 45]. Fibroblast isolated from male Bacterian camel skin were cultured and in vitro multiplied in the laboratory, and cryopreserved to be later used for the revival of this breed using nuclear transfer and animal cloning [46].

In dromedary camels cloning might also be highly beneficial due to their seasonal breeding, prolonged gestation, inter-calving period as well as the difficulty in semen sampling and storage for artificial insemination. The first report of pregnancies and of cloned Camelid (Camelus dromedarius) has been established using cultured somatic cell nuclear transfer [47]. The latter authors also reported, for the first time, that fetal and adult fibroblasts could be frozen, cultured and expanded without any effect regarding their capability for supporting the development of nuclear transfer embryo. The birth of cloned Bactrian camel was reported for the first time by inter-species somatic cell nuclear transfer (iSCNT) using a dromedary camel as an oocyte source and a surrogate for carrying [48]. A recent study [49] concludes that cell type, cell donor together with their treatment affect the cloning outcome by somatic cell nuclear transfer in camels.

Conclusion

The knowledge gained so far on the mechanism of tissue culture-based application in dromedary camels is still in its early stages. However, successful use seems to be promising in some fields such as cloning, veterinary regenerative medicine of musculoskeletal disorders as well as embryonic and Mesenchymal stem cell-based treatment.

Conflict of Interest: None declared.

References


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