

Coconut Water Solutions for the Preservation of Spleen, Ovary, and Skin Autotransplants in Rats

J.M. Schettino César^{a,*}, A. Petroianu^a, L. de Souza Vasconcelos^b, V.N. Cardoso^c, L. das Graças Mota^c, A.J.A. Barbosa^d, C.D. Vianna Soares^c, and A. Lima de Oliveira^a

^aSurgery Department of Minas Gerais Federal University, Belo Horizonte, Brazil; ^bClinical Pathology Department of Minas Gerais University, Belo Horizonte, Brazil; ^cPharmacology Department of Minas Gerais University, Belo Horizonte, Brazil; and ^dPathology Department of Minas Gerais, Belo Horizonte, Brazil

ABSTRACT

Background. The purpose of this study was to evaluate the efficacy of coconut water in the preservation of spleen, ovary, and skin autotransplantations in rats.

Methods. Fifty female Wistar rats were divided randomly into 5 groups on the basis of the following tissue graft preservation solutions: group 1, lactated Ringer's; group 2, Belzer's solution; group 3, mature coconut water; group 4, green coconut water; and group 5, modified green coconut water. In group 5, the green coconut water solution was modified to obtain the same electrolyte composition as Belzer's solution. The spleen, ovaries, and a skin fragment were removed from each animal, stored for 6 hours in one of the solutions, and then re-implanted. The recoveries of tissue functions were assessed 90 days after surgery by means of spleen scintigraphy and blood tests. The implanted tissues were collected for histological analyses.

Results. Higher immunoglobulin G levels were observed in the animals of group 5 than in the animals of group 1. Differences in follicle-stimulating hormone levels were observed between groups 1 and 2 ($P < .001$), between groups 4 and 2 ($P = .03$), and between groups 5 and 2 ($P = .01$). The spleen scintigraphy results did not differ among the groups. The ovarian tissue was better preserved in the mature coconut water group ($P < .007$).

Conclusions. Solutions containing coconut water allowed for the preservation of the spleen, ovaries, and skin for 6 hours, and the normal functions of these tissues were maintained in rats.

TECHNIQUES for organ and tissues preservation for transplantation replace blood with other solutions to render the organ tolerant to hypothermia, reduce metabolism, and avoid vascular obstructions caused by blood clots. The composition of the preservation solution is a determinant of the tolerance of the organ to storage in hypothermic conditions [1,2]. The solution developed at the University of Wisconsin (Belzer) at the end of the 1980s has allowed for significant advances in organ preservation [3].

Studies that used gametes of different animal species have shown that green coconut water (ie, the endosperm of *Cocos nucifera* L.) preserves the pre-antral follicles of goat, sheep, and human semen. This solution also preserves bovine oocytes and embryos [4–7]. On the basis of the importance of the green coconut water, its composition is worth noting

(Table 1). Table 2 presents a comparison of the composition of coconut water to the components of tissue and organ preservation solutions used for transplantation.

The objective of this study was to verify the efficacy of coconut water in the preservation of splenic, ovarian, and skin tissues for autotransplants.

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*Address correspondence to Jorge Miguel Schettino César, Ipês Amarelos Street 821 Nova Lima, MG 34000-000 Brazil. E-mail: jorgemiguels@ig.com.br

Table 1. Coconut Composition [8]

Coconut Type	Young	Young Green	Mature Green	Mature	Mature (Autoclaved)	Young	Mature	
Average Weight of Coconut (g)	206 (water)					565	393	
Age of coconut						6 mo	12 mo	
Source of coconut	Deerfield Beach, FL			Dominican Republic				
Proximates								
Water	94.99 g/100 g					94.18 g/100 g	94.45 g/100 g	
Dry	5.01 g/100 g					5.82 g/100 g	5.55 g/100 g	
Energy value	19 kcal (79 kJ)							
Protein	0.72 g/100 g					0.12 g/100 g	0.52 g/100 g	
Total lipid (fat)	0.2 g/100 g					0.07 g/100 g	0.15 g/100 g	
Ash	0.39 g/100 g					0.87 g/100 g	0.47 g/100 g	
Carbohydrate, by difference	3.71 g/100 g					4.76 g/100 g	4.41 g/100 g	
Fiber, total dietary	1.1 g/100 g					ND	ND	
Sugars								
Total	2.61 g/100 g		9.16 mg/mL	21.68 mg/mL	13.87 mg/mL	15.20 mg/mL	5.23 g/100 g	3.42 g/100 g
Sucrose	9.18 mg/mL		0.93 mg/mL	9.18 mg/mL	8.90 mg/mL	10.70 mg/mL	0.06 g/100 g	0.51 g/100 g
Glucose	7.25 mg/mL		3.93 mg/mL	7.25 mg/mL	2.46 mg/mL	2.02 mg/mL	2.61 g/100 g	1.48 g/100 g
Fructose	5.25 mg/mL		4.30 mg/mL	5.25 mg/mL	2.51 mg/mL	2.48 mg/mL	2.55 g/100 g	1.43 g/100 g
Sugar alcohols	Present ^a							
Mannitol	0.8 mg/mL			0.80 mg/L				
Sorbitol	15 ^d mg/mL			15.00 mg/L				
Myo-inositol	0.01 mg/mL			0.01 mg/L				
Scyllo-inositol	0.05 mg/mL			0.05 mg/L				
Inorganic ions								
Calcium, Ca	24 mg/100 g					27.35 mg/100 g	31.64 mg/100 g	
Iron, Fe	0.01 mg/100 g	0.29 mg/100 g	0.01 mg/100 g			0.02 mg/100 g	0.02 mg/100 g	
Magnesium, Mg	30 mg/100 g	25 mg/100 g	30 mg/100 g			6.40 mg/100 g	9.44 mg/100 g	
Phosphorus, P	37 mg/100 g	20 mg/100 g	37 mg/100 g			4.66 mg/100 g	12.77 mg/100 g	
Potassium, K	312 mg/100 g	250 mg/100 g	312 mg/100 g			203.70 mg/100 g	257.52 mg/100 g	
Sodium, Na	105 mg/100 g	105 mg/100 g	105 mg/100 g			1.75 mg/100 g	16.10 mg/100 g	
Zinc, Zn		0.1 mg/100 g				0.07 mg/100 g	0.02 mg/100 g	
Copper, Cu	0.04 mg/100 g	0.04 mg/100 g	0.04 mg/100 g			0.01 mg/100 g	0.03 mg/100 g	
Manganese, Mn		0.142 mg/100 g				0.12 mg/100 g	0.08 mg/100 g	
Selenium, Se		0.001 mg/100 g						
Chlorine, Cl	183 mg/100 g		183 mg/100 g					
Sulfur, S	24 mg/100 g		24 mg/100 g			0.58 mg/100 g		
Aluminium, Al						0.07 mg/100 g	0.06 mg/100 g	
Boron, B						0.05 mg/100 g	0.08 mg/100 g	
Vitamins								
Vitamin C, total ascorbic acid	24 mg/100 g					7.41 mg/100 dm ³	7.08 mg/100 dm ³	
Thiamin (B1)	0.03 mg/100 g		Trace			Trace	0.01 mg/100 dm ³	
Riboflavin (B2)	0.057 mg/100 g		0.01 mg/L			0.01 mg/100 dm ³	0.01 mg/100 dm ³	
Niacin (B3)	0.08 mg/100 g		0.64 mg/L			ND	ND	
Pantothenic acid (B5)	0.52 mg/mL	0.043 mg/100 g		0.52 mg/L				
Pyridoxine (B6)	0.032 mg/100 g		Trace			ND	ND	

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