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Gender- and age-related variations in blood viscosity in normal volunteers: A study of the effects of extract of *Allium sativum* and *Ginkgo biloba*

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Abstract

This study sought to compare the effects of age and gender on blood viscosity and to appraise the effectiveness of *Ginkgo biloba* and *Allium sativum* extracts in reducing blood viscosity.

Stage 1: Our sample consisted of 80 male volunteers (40 aged 18–60 and 40 aged 61 and over) and 80 females with the same age profile.

Stage 2: We studied 60 male volunteers allocated in groups: placebo, *G. biloba*, and *A. sativum*.

Stage 3: We studied 25 male volunteers and in the initial, intermediate, and final evaluations, the measures of blood viscosity were repeated. Volunteers were given a clinical evaluation and submitted to laboratory tests. *G. biloba* led to the highest reduction in blood viscosity compared with placebo and *A. sativum*. In relation to the use of the two substances, *G. biloba* and *A. sativum*, dry extract of *G. biloba* proved to be more effective in reducing blood viscosity.

Keywords: Blood viscosity; *Ginkgo biloba*; *Allium sativum*

Introduction

Blood viscosity is the overall measure of intrinsic resistance to blood flow (Woodward et al., 2003). It is determined by plasma viscosity, hematocrit, erythrocyte deformation and aggregation, and is an important determinant of blood flow and tissue perfusion (Reinhart, 2001).

There is evidence suggesting that blood viscosity is involved in several pathological processes such as myocardial ischemia, circulation deficits (Lowe et al., 1997), and cognitive deficits (Santos et al., 2003). Furthermore, there are data relating to higher blood viscosity in individuals with sleep apnea (Nobili et al., 2000; Reinhart et al., 2002), hyperlipidemias, and hyperproteinemias (Lowe et al., 2002) with arterial hypertension (Fowkes et al., 2003), in dehydrated individuals (Chan et al., 2002).

There are also reports in the literature of some substances acting to reduce blood viscosity and improve blood circulation. A recent study showed the effectiveness of *Ginkgo biloba* in cognitive improvement in seniors, the effectiveness of dry *G. biloba* extract in reducing blood viscosity after chronic use, and increased cerebral perfusion in non-demented elderly people (Santos et al., 2003).

As well as for *G. biloba*, there are growing numbers of studies pointing to the fact that *Allium sativum* has

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antioxidant (Banerjee et al., 2002; Dillon et al., 2003), neuroprotective (Nahin et al., 2006), and beneficial properties for the cardiovascular system (Budoff, 2006), and hypotensive effect and potential therapeutic use in the treatment of inflammatory processes (Hodge et al., 2002; Sovova et al., 2002). Yet, other studies point to a role in lowering plaque aggregation (Williams et al., 2005; Kiesewetter et al., 1993; Zemcov et al., 1984).

This study sought to compare the effects of age and gender on blood viscosity and to appraise the effectiveness of *G. biloba* and *A. sativum* extracts in reducing blood viscosity. Previous research with dry *G. biloba* extract has shown its potential to reduce blood viscosity over 8 months of treatment (Santos et al., 2003). This study also seeks to find which of the substances produces the least side effects and the period of treatment necessary to produce significant modifications in blood viscosity in order to select the most effective substance with the least side effects.

Materials and methods

Dried extract of *Ginkgo biloba* (EGb761)

The extract used in this study was produced by Maze Produtos Químicos e Farmacêuticos Ltda. and prepared by Magister Medicamentos Ltda. in accordance with the Commission E Monographs (1994). Its composition (per 100 mg) was as follows: 24% flavonoide, 6.1% terpenoide, 2.7% bilobalide, 1.7% ginkgolide A, 0.9% ginkgolide B, and 0.8% ginkgolide C (Commission E Monographs, 1994).

Garlic oil (*Allium sativum*)

Garlic oil was made by chopping (macerating) garlic and incubating it for 24 h in vegetable oil, then removing all pieces of garlic. Garlic macerate oil contains ajoene, highly antibiotic and especially good at inhibiting platelet aggregation, and vinyldithiins, which are water-soluble and circulate through the blood system and probably are more beneficial to the heart and circulatory system. The main components of the volatile oil are sulfur compounds, especially allicin, diallyl disulfide, and diallyl trisulfide. The composition (per 100 mg) obtained by gas chromatography was as follows: diallyl sulfides 1.2%, allylmethyl sulfide 4.2%, diallyl disulfide 21.5%, allylmethyl trisulfide 8.8%, diallyl tetrasulfide 5.0%, and 3-vinyl-1,2-dithiin 5.3%, among other components.

Procedures

Stage 1: Our sample consisted of 80 male volunteers (40 of them aged 18–60 and 40 aged 61–75) and 80 females, with the same age profile.

Stage 2: We studied 60 male volunteers randomly allocated in three groups: placebo (19 individuals), *G. biloba* (25 individuals): 80 mg/day, and *A. sativum* (16 individuals): 250 mg/day. There were 6 dropouts from the placebo group, volunteers who failed to return to repeat the blood viscosity measurement after 6 months. There were no dropouts from the *G. biloba* group, and 9 dropped out of the *A. sativum* group alleging strong skin odor.

Stage 3: We studied 25 male volunteers who repeated their blood viscosity measures in the initial, intermediate, and final evaluations: 25 volunteers (basal); 17 volunteers (30 days); 17 volunteers (90 days); and 23 volunteers (180 days). In the intermediate evaluations, 8 absences were registered in the 1st month and 8 in the 2nd month. At the end of the study, 4 dropouts were recorded.

Volunteers were given a clinical evaluation and submitted to following laboratory tests: full blood count, glycemia, electrolytes, renal and hepatic functions, calcium, magnesium, total cholesterol and fractions, triglycerides, and T_3, T_4, TSH, VDRL, and FTAABS parameters. Volunteers presenting irregularities in these exams were excluded. Blood viscosity was measured using "Wells–Brookfield Cone/Plate Viscometer" DV-I, with a shear rate of 250 s^{-1}. Blood was collected by peripheral puncture in the forearm vein, and stabilized with 0.1% EDTA, since this anticoagulant does not alter blood viscosity (Rand et al., 1964; Rosenblatt et al., 1965). Immediately after collection, blood viscosity was measured at a temperature of 37 °C, following the technique standardized by Galduróz et al. (1995).

ANOVA was used for stage 1, followed by Tukey for uneven N; and the Pearson correlation test; two-way ANOVA was used for the 2nd stage, followed by Tukey for uneven N; the Student "t" test for dependent samples was used for 3rd stage. The significance level was set at $p < 0.05$.

The study was conducted at the Clinical Psychobiology Research Center of the Psychobiology Department, Universidade Federal de São Paulo. All methods and procedures were approved by the Committee of Ethics in Research of Universidade Federal de São Paulo. Before beginning the study, the aims and possible risks were carefully explained to each volunteer, who then signed a consent form.

Results

Fig. 1 shows blood viscosity results by age and gender. Significant differences were found when considering age; measures of blood viscosity in the younger group was significantly lower than in the senior group;