



Effects of dry-cured ham rich in bioactive peptides on cardiovascular health: A randomized controlled trial



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ARTICLE INFO

Article history:

Received 19 April 2017

Received in revised form 5 September 2017

Accepted 8 September 2017

Keywords:

Dry-cured ham

Bioactive peptides

Hypertension

ACE inhibition

Cardiovascular risk factors

ABSTRACT

Establishing health effects of bioactive compounds from dry-cured meat is an active area of clinical research. The present study aims to investigate whether consuming dry-cured ham with biopeptides, among other bioactive compounds, modifies blood pressure (BP) and improves other risk factors for cardiovascular disease in humans. This two-arm, cross-over, randomised controlled trial involved 38 healthy subjects with pre-hypertension. Participants received 80 g/day dry-cured pork ham or 100 g/day cooked ham (control product). A daily intake of 80 g dry-cured ham did not impair BP or 24 h sodium excretion. Total cholesterol, LDL and basal glucose levels dropped after dry-cured ham consumption ($p = 0.00019$, $p = 0.021$ and $p = 0.014$, respectively). Cooked ham did not affect any of the clinical and biochemical markers. Dry-cured ham components could exert a plethora of activities over the cardiovascular system including lipid and glucose metabolism. Additional studies are needed to confirm the effects of dry-cured meat biopeptides on diverse risk factors in pathological conditions.

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1. Introduction

Nutrition is often considered one of the most "modifiable" risk factors in cardiovascular primary prevention, which is why it is frequently used. The scientific community has increased its interest in different food bioactives, from polyphenols to biopeptides (Bahadoran, Mirmiran, & Azizi, 2013; Chakrabarti, Jahandideh, & Wu, 2014). In fact, a large number of dietary supplements and nutraceuticals (of both vegetal and animal origin) have been tested in the development of natural therapies for cardiovascular disease (CVD) prevention such as antihypertensive agents (Alexander, 2014; Kawasaki et al., 2000; Seppo, Jauhainen, Poussa, & Korpela, 2003).

Abbreviations: ACE, Angiotensin I Converting Enzyme; BMI, Body Mass Index; BP, Blood Pressure; CVD, Cardiovascular Disease; DBP, Diastolic Blood Pressure; HDL, High Density Lipoprotein; LDL, Low Density Lipoprotein; RCT, Randomized Controlled Trial; SBP, Systolic Blood pressure; UCAM, Catholic University of Murcia.

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Bioactive peptides are small compounds, comprising 2–20 amino acids and with a wide variety of pharmacological targets. Meat proteins offer huge potential as novel sources of bioactive peptides with a capacity to inhibit angiotensin I converting enzyme (ACE) and display antioxidant, antimicrobial and antiproliferative activities (da Cruz, Pimenta, de Melo, & Nascimento, 2016; Ryan, Ross, Bolton, Fitzgerald, & Stanton, 2011). Dry-cured ham is a traditional and ubiquitous Spanish food, its elaboration dates of hundreds of years and it is an important business in the country (Mora et al., 2015). Important biochemical changes occur during dry-curing, including intense proteolysis due to the action of endogenous muscle peptidases and resulting in the release of a variety of bioactive peptides. In fact, bioactive peptides have been found after hydrolysis (Arihara, Nakashima, Mukai, Ishikawa, & Itoh, 2001) and after *in vitro* simulated digestion of dry-cured ham (Escudero, Aristoy, Nishimura, Arihara, & Toldrá, 2012). Moreover, the *in vitro* antihypertensive capacity of bioactive peptides of Spanish dry-cured ham has been previously reported in rats (Escudero et al., 2012; Escudero et al., 2013). The antihypertensive activity of bioactive peptides was preserved even after the physiological digestion, which could be absorbed along the intestine and

exert a decrease in systolic blood pressure (BP) in rats (Escudero et al., 2012).

Nonetheless, pork leg is salted during ham curing, and the excessive dietary intake of sodium chloride is related with negative effects on human health, including hypertension, and, consequently, an increased risk of CVD (Morgan, Aubert, & Brunner, 2001). A prospective epidemiological study in 13,293 students analyzed the prevalence of CVD, weight gain and hypertension during a six-year follow up period, showing that regular consumption of dry-cured ham (>4 times per week) was not associated with any of these effects despite the higher dietary intake of salt (Ruiz-Canela López et al., 2009). Whether bioactive peptides, among other compounds, from dry-cured ham counteract the salt intake has not been formally demonstrated, although clinical observations could be used to support this concept. The aim of the present randomized controlled trial (RCT) was to investigate whether the consumption of dry-cured pork ham rich bioactive peptides could modify BP and other cardiovascular risk factors.

2. Material and methods

2.1. Ethics statement

The current study was registered in the Clinical Trials Database (ID: NCT02585089), performed in accordance with the Helsinki Declaration and approved by the Ethics Committee of the Catholic University of Murcia (UCAM, April 2015). All enrolled volunteers provided written informed consent.

2.2. Study design and subjects

In the context of the 7FP EU “Beneficial Effects of Bioactive Compounds in Humans (BACCHUS)” project, a two-arm cross-over RCT with diet control was assessed at the UCAM from Septem-

ber 2015 to January 2016. Forty apparently healthy volunteers with untreated high-normal BP were recruited. One group (n = 21) received a controlled salt dry-cured ham of >11 months proteolysis (interventional product) while the other (n = 19) received cooked, uncured ham (control product), each for one month. After a two weeks wash out, the groups exchanged roles for another month. In this way, each group had consumed both meat products for one month (Fig. 1). The study arms were similar for age, gender, ethnicity, body mass index and BP, which allowed comparisons to be made between them (Table 2). The individuals did not know about the purpose of the study or which of the hams was supposed to be the interventional product. The volunteers were enrolled by simple randomisation by only one investigator and the randomization sequence was single-blind until the end of statistical analysis.

Caucasian men and women from the University staff, aged 40–55 years, in good general health and with prehypertension were screened in July–September 2015. An average systolic and diastolic arterial BP of >125 mmHg and >80 mmHg, respectively, was required to take part. Exclusion criteria were: smokers, *Diabetes mellitus*, diagnosed and treated hypertension, history of cardiovascular events (stroke, myocardial infarction or peripheral vascular disease), cancer and inflammation diseases. Medications - anti-hypertensives, antiaggregants, anticoagulants, antidepressants, anti-cholinergic or anti-spasmodic agents, the regular use of medications affecting intestinal motility, vasodilators, lipid lowering therapies and fish oil supplements also acted as exclusion criteria (all other supplements were assessed on a case by case basis).

2.3. Characteristics and dietary habits of volunteers

Information on weight, height, body mass index (BMI, kg/m²), body fat, water, and muscle was collected with bioelectrical impedance using a Tanita BC-541 (Illinois, USA) at the beginning and at

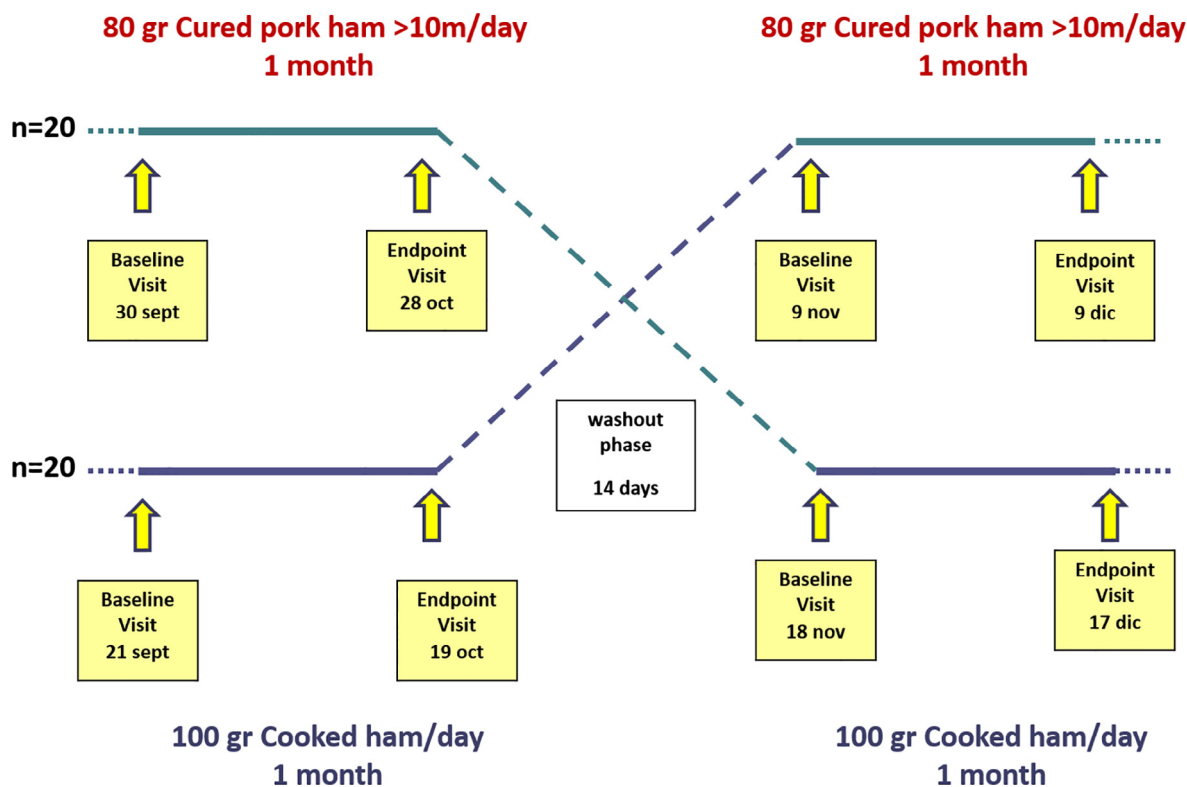


Fig. 1. Study design and timetable.

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