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Anthropometric and serum lipid profiles in overweight men who consumed pork fed with avocado flour

Perfiles antropométricos y de lípidos séricos en hombres con sobrepeso que consumieron carne de cerdo alimentado con harina de aguacate

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ABSTRACT

Human diet can be regulated to generate positive effects on cardiovascular health. The objective was to evaluate the effect of pork consumption fed with 10 % avocado flour on anthropometric profiles and serum lipids in overweight humans over two periods. Two groups of 10 participants each, males aged 30 to 60 years with BMI> 27 kg/m^2, were formed. 100 g of pork loin were consumed daily, group A for four weeks and group B for six weeks. Paired t-test analysis was performed ($p < 0.05$). Group A decreased body fat (-4.04), BMI (-0.92), triglycerides (-51.6), VLDL (-10.32) and increased LDL (48.98). Group B decreased body fat (-1.28), BMI (-1.26), visceral fat (-0.4), waist (-4.4), glucose (-18.5). Using the X^2 test ($p < 0.05$), the proportions of low, normal or high levels were compared after consumption. In-group A, glucose and triglyceride values were normalized, the frequency of the high level for cholesterol and LDL increased, with a decrease in the frequency of low level for VLDL. Group B, the values for glucose, cholesterol, triglycerides, OGT, HDL and LDL were normalized; for VLDL there was a higher percentage of participants at the low level. The consumption of pork loins from pigs fed 10 % avocado meal contributes to the induction of health effects in overweight consumers.

Keywords: Avocado flour, serum lipid profile, pork, overweight, diet.

RESUMEN

La alimentación humana puede regularse para generar efectos positivos en la salud cardiovascular. El objetivo fue evaluar el efecto del consumo de carne de cerdo alimentado con harina de aguacate al 10%, sobre perfiles antropométricos y lípidos en suero de humanos con sobrepeso en dos periodos de tiempo. Se conformaron dos grupos de 10 participantes cada uno, masculinos de 30 a 60 años con IMC >27 kg/m^2. Consumieron diario 100 g de lomo de cerdo, el grupo A por cuatro semanas y grupo B por seis semanas. Se realizaron análisis con prueba de T pareada ($p < 0.05$). Grupo A disminuyó grasa corporal (-4.04), IMC (-0.92), triglicéridos (-51.6), VLDL (-10.32) y aumentó LDL (48.98). Grupo B disminuyó grasa corporal (-1.28), IMC (-1,26), grasa visceral (-0.4), cintura (-4.4), glucosa (-18.5). Usando prueba de X^2 ($p < 0.05$), se compararon las proporciones de niveles bajos, normales o altos, después del consumo. En el grupo A se normalizaron los valores glucosa y triglicéridos, se incrementó la frecuencia del nivel alto para colesterol y LDL, con disminución de frecuencia al nivel bajo para VLDL. Grupo B, se normalizaron los valores para glucosa, colesterol, triglicéridos, TGO, HDL y LDL; para VLDL tuvieron mayor porcentaje de participantes a nivel bajo. El consumo de lomo de cerdos que fueron alimentados con harina de aguacate al 10 %, contribuye a la inducción de efectos saludables en consumidores con sobrepeso.

Palabras clave: Harina de aguacate, perfil de lípidos séricos, carne de cerdo, sobrepeso, dieta.

INTRODUCTION

Human diet can be regulated to generate positive effects on cardiovascular health (Berciano and Ordovás, 2014). Cardiovascular diseases are the leading cause of death around the world, so the nutritional recommendations continue to be seeking to prevent these diseases (Royo-Bordonada *et al.,* 2017). The consumption of healthy and high diet in unsaturated fatty acids has shown numerous health benefits, such as: reducing the prevalence of metabolic syndrome, diabetes mellitus, CVD (cardiovascular disease), mammary cancer and psychoorganic deterioration (Urquiaga *et al.,* 2017). Saturated fatty acids (SFA) are endogenous synthesis, necessary for some physiological and structural functions. A positive relationship has been found between the intake of SFA with the increase of total cholesterol and LDL cholesterol (Low-Density Lipoprotein), which in turn increases the risk of coronary disease (Cabezas-Zábala *et al.,* 2016). Likewise, some studies have shown that total cholesterol concentrations, LDL, VLDL (Very Low-Density Lipoprotein), and Tg (triglycerides) decrease when replacing red meat by fish, due to its high content of monounsaturated fats (Sotos-Prieto *et al.,* 2011). Substituting SFA by monounsaturated (MFA) and polyunsaturated (PFA) reduces cardiovascular risk (Ros *et al.,* 2015). Berciano and Ordovás (2014) found that although red meat can be a risk factor for cardiovascular diseases, this goes more in relation to its content and fat type. Food is a direct influence on serum lipid fractions, so the development of methods and design of different nutritional strategies is being looked for, to modify situations of hypercholesterolemia and hypertriglyeridemia (Cruz, 2018).

OCDE (2019) refers that the pork has been present for a long time in the history of humanity, but there are still prejudices regarding their quality and health effects. It is considered that the growth of worldwide pork production will be at an average annual rate of 0.9% between 2018 and 2027, to be located at 130.9 million tons (FIRA, 2019).

Therefore, they are still looking for feeding strategies for pigs, with the desire to lower production prices, as well as to improve nutritional characteristics of meat, shelf life, palatability, among others. It has been experienced with different feeding and use techniques of conventional and unconventional food sources (Montero *et al*., 2015). The performance and quality of meat can be modulated including sources rich in fatty acids and antioxidants. These strategies lead to improving the biochemical constitution of consumer meat. One of the strategies to convert the meat into a "functional food" (Valenzuela *et al.,* 2014), consists in modifying the profile of intramuscular and subcutaneous fatty acids, with the purpose that they are preferably unsaturated, for greater contribution towards the consumer health. The fact of modifying fats of pork meat, contributing to current overweight and obesity problems, therefore, prevents the incidence of cardiovascular disease, type II diabetes, fatty liver and metabolic syndrome (Savino, 2011). An applied strategy is the use of avocado in pork diet, its use had a significant impact on the content and composition of intramuscular fat, reducing the content of lipids in *Longissimus Thoracis* muscles, increased polyunsaturated fatty acids, tocopherol and it decreased the oxidation of fat and protein (Hernández-López *et al.,* 2016[a]; Hernández-López *et al.,* 2016[b]). In order to study the consumption of pork loins that were fed 10 % avocado flour, a study was carried out to evaluate the effect in two periods on anthropometric and serum lipid profiles in overweight people.

MATERIAL AND METHODS

Location

The present work was carried out in the Nutritional Physiology Laboratory and Experimental Surgery of the Agriculture Academic Unit, belonging to the Autonomous University of Nayarit.

Obtaining and nutritional features of pork

70 kilos of Yorkshire-Landrace breeds were used, fed free access with a diet that included 10 % avocado flour (LAF), for a period of 56 days until the fattening, in accordance with the recommendations of the Mexican Official Standard NOM-062-ZOO-1999. The avocados of the Hass variety (*Persea American* Mill) included in the pig diet were from discarding commercial by its size, without demereing its nutritional value (Lemus *et al.,* 2017). The loins used were characterized in an earlier work (Lemus-Avalos *et al.,* 2020), as a very similar chemical composition meat product, with low intramuscular fat content (5.94%), with 20.93% protein, 10.98 µg/G of γ-tocopherol, 3128 mg of gallic acid/100 g of total phenols. Also, with a high antioxidant activity analyzed with the radical assays DPPH (2,2-diphenyl-1-picrilhydrazyl, D-9132) (477.16 µm trolox/100g) and the radical ABTS (2.2'-azino-bis acid (3-ethylbenzotiazolin) -6-sulfonic, A-1888) (1054.55 µm trolox/100 g). It is a low beef in SFA, including palmitic (C16: 0) (21.93%), which is recognized as the highest saturated fat in pork, with a greater amount of arachid (20: 0) (0.45%). With a high content of polyunsaturated fatty acids, where cis (alpha) essential fatty acid (alpha) (18: 2 N6) represents 12.91%, as well as a high content of PFA (13.82%), so it has a high relationship of PFA/SFA (0.45%) and PFA/MFA (0.25%).

Individuals of study

For the study, 20 male adult participants were chosen between the ages of 30 to 60, with a BMI (body mass index) between 27 to 33 kg/m^2, without a history of cardiovascular disease. They must be intake pork on average once a week, without realization of physical activity, without use of food supplements with omegas fatty acids, no smokers, as well as accepting in writing to participate in the study. This research is attached to the declaration of Helsinki, to General Health Law and has approval from the Nayarit Bioethics State Commission (Nayarit's CEBIOÉTICA) in the trade number 88/CEB/2018, NO/17/2018.

Two study groups were formed; both consumed daily 100 g of pork loin fed 10 % avocado flour (LAF). A group of 10 subjects (group A), consumed it 4 weeks. The other (group B) integrated with 10 subjects, consumed it for a period of 6 weeks. The nutritional history of the individuals was obtained by means of a direct survey.

Diet

Participants were trained to meet during the experiment the recommendations of a balanced feeding according to WHO (OMS, 2017), based on healthy diet characteristics. Advice for the Food Plan was individually, according to the weight, size and age of each subject, in accordance with the FAO Recommendation (Carbajal, 2013), was included in its usual diet, the intake of the pork loin provided in the study.

Anthropometric parameters

The anthropometric evaluation was used to determine the body composition and diagnosed the degree of obesity, using the body mass index (BMI) and the obesity classification proposed by the World Health Organization (OMS, 2020). The anthropometric measurement was performed at the beginning and end of each period in both groups, using a Tanita® brand scale with a sensitivity of ± 100 g, and a digital scale with Bluetooth Bennet® brand. The weight measure was obtained in lightweight and without footwear clothing, and by method of bioimpedance the percentage values of visceral fat and percentage of body fat. With the tape measure, dry brand fixed to a smooth wall, the height (cm) was obtained, respecting the plane of Frankfurt (Porion-Infraorbital) parallel to the ground and the horizontal bipupillary line, supporting the horizontal bar of the statement on the scalp (Martínez and Ortiz, 2013). The BMI was calculated as the reason between the weight in Kilograms and the height squared in meters, considering overweight as an BMI equal or higher 25 (OMS, 2017).

For the obtaining of the waist perimeter (cm) and hip (cm), the Lufkin® metallic tape measured, all measurements were performed using internationally accepted techniques (Marfell-Jones, M. (ISAK) 2001). The waist perimeter (cm) was divided between the hip (cm) to obtain the waist/hip indicator (WHI) as an indicator of the adipose tissue distribution, this indicator is an independent predictor of risk and morbidity factors. It was considered moderate of 0.90 to 0.95 and high higher than 0.95 (Poirier *et al.,* 2006).

Profile of serum lipids

In both groups A and B, blood samplings were held to the participants at the beginning and at the end of the period of four or six weeks of LAF consumption. The sample was obtained from the antecubital vein after 12 hours of fasting; a baseline blood sample of 7 ml was collected in a dry tube. Each sample was placed in test tubes and centrifuged at 4,000 rpm for 10 minutes after which the serum was extracted. For the determination of serum concentration, they were measured with byosistem model A160. Getting measurements of: Glucose mg^2/dL, (TC) Total cholesterol mg/dL, (TG) triglycerides mg/dL, OGT (oxalacetic glutic transaminase) U/L, HDL cholesterol (high density lipoproteins) mg/dl, HbA1c (Glicada hemoglobin) %, LDL cholesterol (low density lipoproteins) mg/dL, was calculated from TC, GT and HDL using the Friedewald formula (LDL = TC-HDL-GT/5) provided that GT <400 mg (Troyo-Barriga, 2004). To estimate the value of the VLDL cholesterol 5 (mg/dl) divided (very low-density lipoproteins) mg/dl, the triglyceride concentration (D'Isa *et al*., 2013).

Statistical analysis

With anthropometric data and serum lipid profiles obtained, descriptive analyzes and comparison between variables were performed, using quantitative analysis with paired T, to compare in each group the differences between the start and final periods of LAF consumption. A qualitative analysis was also performed in the variables of the serum profiles, a qualitative analysis by means of the X^2 test, comparing the proportions according to the low levels (b), (n) normal or (a) tall in each group comparing the differences Among the start and end period of LAF consumption. For the analysis, the SPSS® STATISTICS 20 (SSPS, 2011) software was used.

RESULTS

Table 1 presents the anthropometric variables of the subjects studied, it is observed that in the participants included in both groups (A and B) decreased significantly (p <0.05) body fat and BMI, observing that when the period is increased to six weeks LAF consumption (group B), visceral fat and the perimeter of the waist decreases significantly.

Table 2, the average values of Group A and Group B are presented, of the serum lipid profiles of the participants who consumed LAF. It is shown that in Group A (4 weeks), they decreased significantly (p <0.05) the triglyceride and VLDL values, with an increase in LDL. They are also observed that glucose, cholesterol, OGT, HDL and HbA1C are not affected. In-group B (6 weeks), only glucose (p <0.05) only decreased significantly. The rest of the variables were not affected by the LAF consumption.

Table 1. Anthropometry in participants who consumed pork loins fed with 10% avocado flour

	Group A				Group B			
	Mean		Differences		Mean		Differences	
VARIABLE	I	F	DIF F-I	p<	I	F	DIF F-I	p<
Body fat	34.76	30.72	-4.04	**	28.9	27.6	-1.28	**
BMI	33.04	32.12	-0.92	**	30.9	29.6	-1.26	**
Visceral fat	16.6	15.8	-0.8	ns	14.6	14.2	-0.4	**
Waist perimeter	106.7	104.2	-2.5	ns	99.8	95.4	-4.4	**
WHI	0.98	0.96	-0.02	ns	0.92	0.90	-0.02	ns

Group A: consumption for 4 weeks. Group B: consumption for 6 weeks. BMI: Body Mass Index, WHI: Waist-Hip Index. I: Start of consumption of meat. F: Final of meat consumption DIF: Differences, NS: Non-significant. ** P <0.05 of the tested T paired.

Table 2. Serum lipid profiles in participants who consumed pork loins fed 10% avocado flour during the two consumption periods

		Group A				Group B			
PERIOD OF TIME		Mean		Differences		Mean		Differences	
		I	F	F-I	p<	I	F	F-I	p<
GLUCOSE	mg/dL	111.2	100.0	-11.2	ns	107.2	88.7	-18.5	*
CHOLESTEROL	mg/dL	194.6	220.2	25.6	ns	185.8	169.1	-16.7	ns
TRIGLYCERIDES	mg/dL	218.4	166.8	-51.6	**	157.8	136.2	-21.6	ns
OGT	U/L	29.4	28	-1.4	ns	31.1	28.1	-3	ns
HDL	mg/dL	58.2	52.7	-5.5	ns	52.0	50.6	-1.4	ns
LDL	mg/dL	95.9	144.9	48.9	**	131.1	79.6	-51.4	ns
VLDL	mg/dL	43.6	33.3	-10.3	**	31.6	27.9	-3.6	ns
HbA1c	%	4.8	4.7	-0.1	ns	4.9	4.8	-0.0	ns

Group A: consumption for 4 weeks. Group B: consumption for 6 weeks. I: Start of consumption of meat. F: Final of meat consumption. OGT: ASPARTATE AMINOTRANSFERA, HDL: High density Lipoproteins, LDL: Low-density Lipoproteins, VLDL: Very low density lipoproteins, HbA1c: Glicada hemoglobin. ** p <0.05; * P <0.10 of the tested T paired.

The percentage changes of the serum lipid profiles and end of the study were compared (Table 3), in Group A (4-week) participants it was observed that significantly increased levels to normal glucose values (from 40 to 60 %) and triglycerides (from 20 to 60 %). The percentage of cholesterol and LDL increased to high ranges. In VLDL the percentages were tending to low levels. The rest of the variables did not suffer modification. Individuals of Group B (6 weeks) increased the percentage of individuals with values within normal glucose ranges (from 40 to 90 %), cholesterol (from 80 to 90 %), triglycerides (from 40 to 70 %), OGT (from 0 to 10 %), HDL (from 70 to 90%) and LDL (from 50 to 90%). In the results of VLDL increased, the percentage of individuals with values within the low ranges and HbA1C was not modified. Therefore, better results for health are shown in-group B participants.

Table 3. Percentage changes in profiles of blood lipids in participants who consumed pork loins fed with 10% avocado flour

	GROUP A							GROUP B						
VARIABLES	I			F			I vs F	I			F			I vs F
LEVELS	B	N	A	B	N	A	p <X^2	B	N	A	B	N	A	p <χ^2
GLUCOSE %	0	40	60	0	60	40	**	0	40	60	0	90	10	***
CHOLESTEROL %	0	60	40	0	40	60	**	0	80	20	0	90	10	**
TRIGLYCERIDES %	0	20	80	0	60	40	***	0	40	60	0	70	30	***
OGT %	80	20	0	80	20	0	ns	100	0	0	90	10	0	***
HDL %	0	80	20	0	80	20	ns	10	70	20	0	90	10	***
LDL %	20	80	0	0	80	20	***	30	50	20	10	90	0	***
VLDL %	20	40	40	60	40	0	***	40	50	10	70	30	0	***
HbA1c %	0	100	0	0	100	0	ns	0	100	0	0	100	0	ns

Group A: consumption for 4 weeks. Group B: consumption for 6 weeks. I: Start of consumption of meat. F: Final of meat consumption. Percentage of participants found at Levels B: Low, N: Normal, A: High. Glucose (70-100mg/dl), cholesterol (125-200mg/dl), triglycerides (10-150mg/dl), OGT: Aspartate aminotransferase (40-50U/L), HDL: High density lipoproteins (35-65mg/DL), LDL: Low density lipoproteins (13-65 mg/dl), VLDL: Very low density lipoproteins (2-30 mg/dl), HbA1c: Gliced hemoglobin (4-5.6 %). p <: Statistical probability of test X2 (*** p <0.001, ** P <0.05, NS: Non significant).

DISCUSSION

Anthropometric parameters

This study was designed to evaluate the effect in two LAF consumption periods over anthropometric and serum lipid profiles in overweight people. It was observed that all study participants declined significantly body fat, BMI, showing that when the consumption period of LAF is increased six weeks (Group B), better results were also decreased, visceral, and waist variables. This could be explained by the linoleic acid content of the flesh, considered essential fatty acid that benefits the reduction of body fat (Arenas and López, 2009) and body weight (Sanhueza *et al*., 2002).

Celada *et al*. (2015) studied people with cardiovascular risk, added meat products, where animal fat was replaced by a combination of olive oil, flaxseed and fish, in three periods of 4 weeks each, reported a decrease in body fat, a waist -hip ratio and waist perimeter. In the fat reduced feeding period and the BMI was reduced, improved the ideal weight in the diet period enriched with fatty acids. These reports coincide with the study carried out here since the anthropometric parameters in individuals consume functional foods also decrease; what suggests that the intake of meat products with less fat or enriched with UFA, improves anthropometric markers, being able to reduce the risk to develop CVD.

There is a correlation between BMI and percentage of body fat (PBF). According to this, it can understand the decrease in BMI when lowering the PBF. Likewise, it was determined that the prevalence of visceral adipose tissue is related to BMI and hip circumference (García *et al.,* 2016). The increase in abdominal adipose tissue (visceral), promotes greater synthesis and release of adipocine in addition to leptin, resistin, angiotensinogen, pro-inflammatory cytokines (tumor necrosis factor [TNF] -α, interleukin [IL] -6, inhibitor of the Plasminogen activator Type 1 [PAI1]) and quemochinas. It can deteriorate Lipid and Glucidic metabolism through the increase in insulin resistance, and increase cardiovascular risk, so measuring the waist/hip index (WHI) is useful in the prediction of cardiometabolic risk Hernández-Rodríguez *et al*. (2018).

According to González-Acevedo *et al. (*2013) changes could be due to the supplementation with UFA inhibits pre-adipocytes differentiation and increases the apoptosis of these cells, as well as intervene in regulation on the sympathetic nervous system, in the production of leptin and adiponectin. This function is manifested with the regulation of body fat that leads to changes in the distribution of fat-free mass ratio (Parra and Hernández, 2017).

Profile of serum lipids

It was observed that the consumption of LAF, in the individuals of Group A (4 weeks) significantly decreased TG, VLDL levels and increased LDL. The values of the individuals of Group B (6 weeks) are also shown, observing significant differences in the decrease in glucose.

Better results are observed when consumed for longer (6 weeks) of LAF because a greater number of favorable health variables were modified. The content of essential fatty acid cis of the meat consumed can be associated with the antiathyrogenic effects found, due to its hypocolesterolemic and hypotrogracyreidemic action (Sanhueza *et al.,* 2002). As well as the phenolic compounds of the flesh due to its antioxidant properties that play an important role in the prevention of diseases such as cardiovascular disorders, type two diabetes, among others (Zapata *et al.,* 2014).

Similar results reported Petzke *et al.,* (2011), in a study conducted in young, healthy and normal weight women who consumed daily 200 g of pork for four weeks, observing that total cholesterol concentrations (- 7 %), LDL cholesterol (-8 %) and glucose (-4 %). Delgado-Pando *et al.* (2014), they conducted a study on 22 volunteers to evaluate the consumption effect of Frankfurters sausage and Pate, reduced in fat and enriched with Omegas, after use in 3 periods of 4 weeks, with breaks between them of 4 weeks; finding decrease in c-LDL, Rusty c-LDL and c-LDL/c-HDL ratio in participants. Similar results observed Maciá *et al.* (2005), when they studied people with hypercholesterolemia (18 women and 18 men), consumed 100 g/day of Iberian Ham of acorn and Olive Oil, the participants presented a decrease in total cholesterol, triglycerides and LDL cholesterol when they were consumed so much PFA as an Iberian ham of acorn, remained with normal HDL levels.

The results presented in this investigation, coincide with what is observed by Pastoriza *et al.* (2017), who carried out a study with the intake of a functional food and observed that participants reduced blood glucose levels significantly due to catechins present in the diet and their action on enzymes for the control of post-pandary hyperglycemia.

For TG our results coincide with Díaz-Perilla and Toro (2004) who evaluated a diet rich monounsaturated fat for 4 weeks that significantly reduced triglycerides by 18.1 %. It is considered that the effect is greater if part of hypertriglyceridemia compared with normal levels of triglycerides (Leslie, 2007), the same effect that could be produced in this work.

In the meta-analysis of (López-Huertas, 2012) it is concluded that there is sufficient evidence to affirm that the intake of dose> 1g of UFA in patients with metabolic syndrome for at least 3 months produce a significant reduction of plasma triglycerides in a variable range between 7-25 %.

The presence of phenolic compounds, including flavonoids, could explain the hepatoprotective effect shown by the consumption of LAF due to its demonstrated antioxidant activity, because of a combination of its iron chelating properties and free radical sequestrators (Bermúdez-Toledo *et al.,* 2014). In addition to the phenolic compounds present, in the LAF, other natural antioxidants with immunomodulatory effects, anti-inflammatory, antifibrotic, free radical sequestrators and membrane stabilizers. They could contribute to protecting the liver of degenerative changes. As well as the presence of γ-tocopherol and its 2,7,8-trimethyl-2- (β-carboxietyl) -6-hydroxicroman metabolite have already been demonstrated to have anti-inflammatory activity (Fernandes *et al.,* 2011), by the inhibition of the enzymatic activity of cyclooxygenase-2 (COX-2), (Muñoz-Velázquez *et al.,* 2012).

Some authors consider that a balanced and adequate dietary intake can play a beneficial role when the profile of lipids in the blood is unfavorable and suggest that the risk of dyslipidemia can be modified according to the type of fat ingested (Peou *et al.,* 2016). It considers that oleic fatty acid present in avocado, can play an active role in the reduction of cholesterol and triglycerides in plasma, as well as reduce the C-LDL without greater change in c-HDL, reducing the risk of CVD.

Decreasing the consumption of nutritional sources with SFA helps prevent the development of Diabetes Mellitus type 2 (Mirmiran *et al.,* 2018). A review study published in 2017 reported that subjects who have a low diet in SFA showed better anti-inflammatory profiles, or at least one proinflammatory response (Rocha *et al.,* 2017). These findings suggest that the consumption of food with UFA (unsaturated fatty acids), contributes to improve inflammatory state and consequently prevent the development of insulin resistance, diabetes and cardiovascular disease.

It is considered in this study that food treatment was modified with respect to fatty acids in the same way as in other studies, (Jiya *et al.,* 2015). The profile of fatty acids in monogastric animals is almost a direct reflection of the fatty acids of their diet. Therefore, the LAFs that were consumed by the participants contain SFA preferably modified by UFA, managing the lipid profile (Lemus-Avalos *et al.,* 2020). By using pork fed with avocado, it is not only incorporated into the meat for human consumption PFA but also, antioxidants that can benefit the health to the consumer (Hernández-López *et al.,* 2016[a]; Hernández-López *et al.,* 2016[b]).

CONCLUSION

The daily intake of pork loin fed 10 % avocado flour, in participants of the two consumption periods of 4 and 6 weeks significantly decreased anthropometric body fat and BMI, overweight associated, metabolic and cardiovascular alterations. In profiles of serum lipid decreased triglycerides, VLDL and glucose; The percentages were increased to normal glucose, cholesterol and triglycerides ranges, with a better result in Group B with 6 weeks of pork loin consumption powered by 10% avocado flour.

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