**Effects of different products of peach (Prunus persica L. Batsch) from a variety developed in southern Brazil on oxidative stress and inflammatory parameters in vitro and ex vivo**

Juciano Gasparotto,¹*, Nauana Somensi,¹ Rafael Calixto Bortolin,¹ Karla Suzana MoreSCO,¹ Carolina Saibro Girardi,¹ Karina Klafke,¹ Thallita Kelly Rabelo,¹ Maurilio Da Silva Morrone,² Márcia Vizzotto,² Maria do Carmo Bassols Raseirã,² José Claudio Fonseca Moreira¹ and Daniel Pens Gelain¹

¹Centro de Estudos em Estresse Oxidativo, Departamento de Bioquimica, Instituto de Ciências Básicas da Saúde, Universidade Federal do Rio Grande do Sul (UFRGS) Brazil, Rua Ramiro Barcelos, 2600-anexo, CEP 90035-003, Porto Alegre, RS, Brazil
²Embrapa Clima Temperado, Empresa Brasileira de Pesquisa Agropecuária, Pelotas/RS Brazil

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Antioxidant, anti-glycation and anti-inflammatory activities of fresh and conserved peach fruits (Prunus persica L. Batsch) were compared. Fresh peach pulps, peels, preserve peach pulps and the preserve syrup were prepared at equal concentrations. Rat liver, kidney and brain cortex tissue slices were pre-incubated with peach samples, subjected to oxidative stress with FeSO₄ and hydrogen peroxide. Fresh peach pulps and peel conferred higher protection against cytotoxicity and oxidative stress than preserve peach pulps in most tissues. Release of tumor necrosis factor-α and interleukin-1β was also significantly decreased by fresh peach pulps and peel, followed by preserve peach pulps. Total phenolic determination and HPLC analysis of carotenoids showed that the content of secondary metabolites in fresh peach pulps and peel is significantly higher than in preserve peach pulps, while the syrup had only small or trace amounts of these compounds. Fresh peach pulps and peel demonstrated high antioxidant and anti-inflammatory effects preventing against induced damage.

**Key Words:** antioxidant, anti-inflammatory, peach, protective effect

Poor dietary intake of fruits and vegetables constitute a risk factor for several diseases such as cancer, coronary heart disease, stroke and insulin resistance.¹,² The regular consumption of fruits and vegetables is associated to prevention of esophageal, stomach, pancreatic, bladder and cervical cancers; fruits and vegetables-enriched diets may prevent 20% of most types of cancers.³ A meta-analysis of cohort studies observed that the risk of developing coronary heart disease and stroke decreased significantly for each additional portion of fruit consumed per day, indicating a protective effect.⁴ It was also reported that fruit dietary intake may be associated with a reduced risk of Alzheimer’s disease and lower cognitive decline with age.⁵ Some fruit and vegetable also may play an important role in delaying the onset of Alzheimer’s disease, particularly among those who are at high risk for the disease.⁶

Free radicals and related species (collectively known as reactive species) are constantly produced by cells as result of aerobic metabolism. Excessive production of reactive species may lead to oxidative stress, which results in oxidative damage to lipids, proteins and DNA. Consequently, increased risk for developing diseases associated oxidative stress, such as cancer, cardiovascular diseases and neurodegenerative conditions, may arise.⁷ To cope with reactive species, cells must maintain an adequate pool of enzymatic and nonenzymatic antioxidants to properly clean/detoxify these species. Among the nonenzymatic antioxidants, exogenous compounds obtained from the diet exert an important role in the detoxification of free radicals and, in turn, in disease prevention. Phenolic compounds and carotenoids obtained from dietary vegetables and fruits exert prominent roles in the protection against oxidative damage.⁸ A reduced risk of developing diseases commonly associated to oxidative stress has been associated to diets enriched in these compounds.⁹

Different varieties of peaches (Prunus persica L. Batsch) are highly consumed worldwide. Peach is the most important stone fruit crop in many western countries, being grown in Europe, North and South America at a fair range of different climate conditions and types of soils. Peaches are appreciated in different cultures mainly due to their flavor and nutritional value; however, studies on potential benefits of peaches consumption to human health are still incipient. Peaches present many secondary metabolites, such as phenolic compounds, carotenoids and tocopherols that present important biological actions and are associated to disease prevention, as mentioned above. Nonetheless, most pharmacological studies focused on the biological activities enriched fractions and/or isolated forms of these compounds and only few studies evaluated the potential of peaches and its derivate products as functional foods. Recently, consumers over the world have been increasingly searching for foods that have a clear role in health-promotion or disease prevention, so producers have been considering such preferences when developing new varieties of agricultural products. In the case of fruits, the present trend is the reinforcement of the content or availability of plant endogenous compounds with potential antioxidant, anti-glycemic, anti-inflammatory and anti-tumoral activities, without affecting other nutritional and flavor-associated properties.

In Brazil, peaches of the Maciel variety have been developed at temperate climate for consumption of the fresh fruit as well as its derivate products, such as juice and syrup-preserved pulp. However, little is known about potential health benefits of this commercial variety of peach and, especially, about the biological activity of the main products commercially available from peaches, such as the fresh fruit and the syrup-preserved pulp. In

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¹To whom correspondence should be addressed.
E-mail: Juciano.gasparotto@gmail.com

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this regard, this study has been conducted to determine the cyto-
protective, antioxidant and anti-inflammatory properties of
peaches of the Maciel variety, developed by Embrapa (Brazilian
Agricultural Research Corporation), using in vitro and ex vivo
assays. Our results indicate that fresh peach pulps (FPP) and
peels exhibit antioxidant, anti-glycation and anti-inflammatory
properties, and that some of these properties are also present in
syrup-based peach pulp preserves (PPP).

Material and Methods

Chemicals. Catalase (CAT, EC 1.11.1.6), superoxide dis-
mutase (SOD, EC 1.15.1.1), thiobarbituric acid (TBA), ferrous
sulfate (FeSO₄), hydrogen peroxide (H₂O₂) were from Sigma-
Aldrich (St. Louis, MO). EMISA microplates were from Greiner
Bio-One (Monroe, LA) and ELISA TMB spectrophotometric
detection kit was from BD Biosciences (San Diego, CA). Tumor
necrosis factor alpha (TNF-α) rabbit polyclonal antibody,
Interleukin-1 beta (IL-1β) rabbit polyclonal antibody and anti-
rabbit immunoglobulin linked to peroxidase were from Cell
Signaling (Danvers, MA). Purified recombinant TNF-α protein
was from Abcam (Cambridge, UK) and IL-1β was from BD. MilliQ-purified H₂O was used for preparing solutions. Lactate
dehyrogenase (LDH) activity kit was from Labtest (Lagoa Santa,
Minas Gerais, Brazil). The following HPLC standards were
butyl and methanol, were purchased from Scientific Hexis
Animals. Adult male Wistar rats (60 days-old; weighing 280–
300 g) were obtained from our breeding colony. They were caged
in groups of four animals with free access to standard commercial
food (CR1 lab chow, Nuvilab, Curitiba, Paraná, Brazil) and water
and were maintained in a 12-h light–dark cycle (7:00–19:00) in a
temperature-controlled colony room (21°C). All experimental
procedures were performed in accordance with the guidelines of
the National Institutes of Health.⁷⁰ Our research protocol was
approved by the Ethical Committee for Animal Experimentation
of the Universidade Federal do Rio Grande do Sul. Ten healthy
animals were utilized for this study. A pilot test was performed
with three animals to determine optimal induction of hydroxyl-
mediated damage by Fenton reaction (FeSO₄ and H₂O₂).

Preparation of peach samples. The Maciel variety was
developed by Embrapa Clima Temperado by controlled hybridiza-
tion. The seeds were laminated in chamber at 4 ± 1°C and then
seedlings were cultivated in greenhouse for later being trans-
planted to the seedlings experimental field. Fruits were obtained
from this field (Pelotas, Rio Grande do Sul, Brazil, location
coordinates: −31°30′57.44′′, 52°33′11.52′′). Immediately after
harvesting the fruits, the peel and pulps were separated and frozen
at −20°C (the pits were removed and discharged). Fruits were
also used to prepare syrup-based preserves by an industrial
preparation. Kidney, liver and brain cortex were quickly removed
and were maintained in a 12-h light–dark cycle (7:00–19:00) in a
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resulted in fluorescent product formation, which was quantified in a fluorimeter (F2000, Hitachi Ltd., Tokyo, Japan) with an excitation wavelength of 350 nm and an emission wavelength of 450 nm. Glycation inhibition was calculated as follows: Inhibition % = 1 – (As – Ab)/(Ac – Ab) × 100, where As = fluorescence of the incubated mixture with sample, Ac = the fluorescence of the incubated mixture without sample (positive control for induced glycation) and Ab = the fluorescence of the sample as a blank control.

**Determination of total phenolic content.** Total phenolic content of peaches and derivatives was determined using the Folin–Ciocalteu method. One hundred μl of Folin–Ciocalteu reagent were mixed to 100 μl of sample and then 200 μl of Na₂CO₃ 35% were added. The volume was completed to 1,900 μl with ultra-pure H₂O and then homogenized. After 10 min, the absorbance was measured at 725 nm and compared to a gallic acid calibration curve. Total phenols in samples were determined as gallic acid equivalents.

**Quantification of carotenoids by High-Performance Liquid Chromatography (HPLC).** Carotenoid analysis was performed using an HPLC system (Agilent series 1100, Santa Clara, CA) equipped with an online degasser, a quaternary pump, and an automatic injector. The carotenoids were separated on a polymeric reversed phase column (YMC C₃0 250 μm × 4.6 μm; particle size of 3 μm) with a mobile phase gradient elution starting with water/methanol/MTBE (Methyl tert-butyl ether) at 5:90:5 and reaching 0:95:5 after 12 min, 0:89:11 after 25 min, 0:75:25 after 40 min and 0:50:50 after 60 min with a flow rate of 1 ml/min at 33°C. The spectra were conducted between 250 and 600 μm, and the chromatograms were processed at a fixed wavelength of 450 nm for carotenoids. Identification was performed by comparison of peak retention times obtained in each sample with the retention times of standards analyzed under the same conditions and co-injection of standards. Quantifications were performed constructing standard curves for the carotenoids in the following concentration ranges: 5–4,000 μg/ml for β-carotene, 2–200 μg/ml for α-carotene, 1–1,000 μg/ml for all-trans-lutein, 4–4,000 μg/ml for cryptoxanthin and 1–500 μg/ml for zeaxanthin. The standards were dissolved in MTBE and analyzed under the same conditions. The limits of detection (LOD) and limits of quantification (LOQ) were determined as previously described by Long and Winefordner. The following LOD and LOQ scores were, respectively obtained: 6.5 × 10⁻² and 10.9 × 10⁻² mg/kg for β-carotene; 6.9 × 10⁻³ and 1.2 × 10⁻² mg/kg for lutein; 2.1 × 10⁻² and 3.5 × 10⁻³ mg/kg for cryptoxanthin; 9.6 × 10⁻² and 1.6 × 10⁻² mg/kg for zeaxanthin; and 2.0 × 10⁻² and 3.3 × 10⁻² mg/kg for α-carotene.

**Cytotoxicity: measurement of LDH activity.** The cell viability of the tissue slices was assessed by LDH activity into the incubation medium. This assay was performed by using a commercial kit for LDH (Code: 86-2/30) from Labtest (Lagoa Santa, Minas Gerais, Brazil) according to the manufacturer’s instructions. The change in absorbance at 500 nm was followed in a...
We first evaluated the total antioxidant capacity of the different samples obtained from peach and derive products. We suspended the lyophilized samples of FPP, peel, PPP and preserve peach syrup in water at the same concentration each (20 μg/ml) and subjected them to the TRAP assay. This assay is widely used to determine the non-enzymatic antioxidant capacity in plant extracts, which is mostly dependent on the content of secondary metabolites, as seen in previous works. The results showed that the peel has the highest antioxidant activity compared with other samples; the FPP also had a significant antioxidant capacity (Fig. 2A and B). PPP and syrup had no significant effects. Trolox (200 nM), hydrophilic analogue of α-tocopherol, was used as a standard antioxidant.

The total antioxidant reactivity (TAR) index indicates the instantaneous decrease in luminescence associated with the sample addition into the peroxy radical-generating system. While TRAP indicates the quantity of antioxidants presents in the plant extracts, the TAR indicates their antioxidant effectiveness. Peel and FPP had the highest TAR indexes, compared to PPP and syrup (Fig. 2C). This result indicates that both the FPP and the peel have a high content of molecules with significant antioxidant activity, which is probably associated to the composition of secondary metabolites, as seen in previous works. When comparing the peel and FPP with other samples it is evident that the samples from fresh fruits (i.e., peels and FPP) had a higher antioxidant activity than samples from preserves (PPP and syrup). These findings suggest that some properties of the peaches are lost by the preserves over time or during the processing procedure, which agrees with previous observations showing that biological properties of industrialized/canned fruits are lower than in fresh fruits. It is also possible that the high antioxidant potential of the fresh peaches is associated to its preservation capacity over time, as it is known that antioxidants help to preserve flavor and nutritional value of foods. Natural and synthetic antioxidants are widely used in the food preservation industry for this reason, and it might be possible that in syrup-based peach preserves they are oxidized over time, preserving other components of nutritional value of oxidation and consequent degradation.

Glycation is a spontaneous non-enzymatic amino-carbonyl reaction between reducing sugars and long-lived proteins and lipids. Glycation is one major form of chemical modifications to biomolecules that compromise their function and have been recently implicated in the molecular basis of several diseases, such as diabetes, cardiovascular pathologies and neurodegenerative diseases. These chemical modifications frequently result in the formation of the so-called advanced glycation endproducts (AGE). Glycation is a source of reactive oxygen species (ROS), causing oxidative stress, which in turn may trigger the production and release of inflammatory mediators. Besides, both AGE and oxidative stress enhance the expression of the receptor for advanced glycation endproducts (RAGE) in cells, which further activates pro-inflammatory pathways and NADPH oxidase-derived ROS production. Antioxidants are reported to prevent the oxidative reaction of sugars with proteins and thus inhibit the formation of Amadori products, which is an early step in AGE formation. Several reports indicate that production of radicals and highly reactive oxidants is increased by glycated proteins under physiological conditions. We subjected isolated albumin to a glycation protocol through incubation with glucose and fructose during 21 days. At the end of the incubation period, albumin glycation was significantly inhibited by peel and FPP by 40% at different doses (Fig. 2D). PPP also inhibited albumin glycation, but at a lower extent (around 10%), while the syrup alone, probably due to its high sucrose content (more than 20%), enhanced glycation by 30%.

We next evaluated the effects of FPP, peel, PPP and syrup on parameters of cytotoxicity, oxidative stress and inflammation by using an ex vivo approach. Rat kidney, liver and brain cortex tissue...
slices were isolated and pre-incubated with the different samples obtained from peaches and its products (80 μg/ml) for 60 min. Then we subjected the tissue slices to an oxidative insult by incubation in a hydroxyl radical production system with FeSO$_4$ 1 mM and H$_2$O$_2$ 100 mM for 30 min. LDH activity in the incubation medium was assessed as a parameter of cytosolic leakage (cytotoxicity). The oxidative insult by the FeSO$_4$/H$_2$O$_2$ system (hydroxyl generating system) increased LDH activity in the incubation medium of all tissues analyzed (Fig. 3A, D and G). In kidneys (Fig. 3A), FPP, peel and PPP prevented the increase in LDH caused by the hydroxyl generating system, indicating a protective effect. In liver (Fig. 3D), FPP and peel had a significant protective effect. In brain cortex (Fig. 3G), only FPP had a significant effect on LDH activity.

The FeSO$_4$/H$_2$O$_2$ system induces cytotoxicity by oxidative stress, as consequence of Fenton reaction. Antioxidant enzymes are known to be induced in response to reactive species.$^{(33)}$ CAT and SOD have their activities increased when H$_2$O$_2$ and superoxide radicals are overproduced during cellular oxidative stress. Thus, enhanced CAT and SOD activities are common parameters indicative of a increased state of reactive species production.$^{(34)}$ As expected, incubation with the FeSO$_4$/H$_2$O$_2$ system increased LDH activity in the incubation medium of all tissues analyzed (Fig. 3A, D and G). In kidneys (Fig. 3A), FPP, peel and PPP prevented the increase in LDH caused by the hydroxyl generating system, indicating a protective effect. In liver (Fig. 3D), FPP and peel had a significant protective effect. In brain cortex (Fig. 3G), only FPP had a significant effect on LDH activity.

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We also measured parameters of oxidative damage in biomolecules to assess the antioxidant properties of peaches to tissue slices. The oxidative damage to the proteins in tissue slices was measured by determining levels of the carbonyl groups based on the reaction of the groups with dinitrophenylhydrazine (DNPH). Formation of protein carbonyl groups is a well-known parameter of protein oxidation.$^{(25)}$ Protein carbonylation was greatly enhanced by the FeSO$_4$/H$_2$O$_2$ system in all tissues, but pre-incubation with FPP protected all tissues against this effect (Fig. 4A, D and G). PPP was able to prevent carbonyl formation in kidney (Fig. 4A). We also measured the total content of thiol groups, which indicates the level of protein SH groups oxidation, as SH groups are oxidized in response to pro-oxidant stimuli.$^{(23)}$ Protein SH oxidation was not prevented statically by any pre-treatment (Fig. 4B, E and H), however in liver (Fig. 4E) FPP group had no difference to control group indicating a possible protection. Lipid peroxidation is considered one of the basic mechanisms involved in reversible and irreversible cell and tissue damage. Lipid peroxidation has been implicated in the pathogenesis of many diseases. In liver, it is an early marker of cell membrane activation.
damage associated with the subsequent leakage of hepatotoxicity markers to the bloodstream.\(^{(35)}\) Lipid peroxidation (expressed as TBARS) was significantly increased in samples treated with the FeSO\(_4\)/H\(_2\)O\(_2\) system. \(^{(35)}\) Pretreatment with peel significantly reduced increase in TBARS formation in all tissue slice samples (Fig. 4C, F and I). In brain cortex slices (Fig. 4I), FPP also had a protective effect. \(^{(35)}\) The observation that peach peels presented antioxidant activity mainly in the lipid fraction (Fig. 4C, F and I), while FPP had a major antioxidant effect to soluble protein fractions (Fig. 4A, D and G) suggest that different secondary compounds present in distinct parts of the fruit (i.e., pulp and peel) are responsible for these effects.

In response to acute or chronic infection, the production and release of TNF-\(\alpha\) and IL-1\(\beta\) is increased. These cytokines trigger pro-inflammatory signal cascades in tissues, enhancing reactive species production and further cytokine expression and release. \(^{(35)}\) In order to analyze the potential anti-inflammatory effects of peaches on tissues, TNF-\(\alpha\) and IL-1\(\beta\) levels in the incubation medium were quantified by ELISA as previously described.\(^{(35)}\) The incubation with the FeSO\(_4\)/H\(_2\)O\(_2\) system led to a significant increase in the levels of TNF-\(\alpha\) and IL-1\(\beta\) in the incubation medium of all tissues, indicating an acute inflammatory response (Fig. 5). In kidney tissue (Fig. 5A and B), the FPP, peel and PPP prevented the release of TNF-\(\alpha\) and IL-1\(\beta\). In the liver (Fig. 5C and D), only the peel caused a similar effect, preventing the increase of TNF-\(\alpha\) and IL-1\(\beta\) release caused by the pro-oxidant insult. FPP also inhibited the release of TNF-\(\alpha\) in brain cortex (Fig. 5E).

As mentioned earlier, plant secondary metabolism is responsible for the synthesis of many compounds that exert important biological activities in animal cells when ingested as part of animal diet. Phenolic compounds are found in many different foods, especially fruits and vegetables.\(^{(35)}\) Dietary phenolic compounds have been considered essential for prevention of oxidative stress-mediated diseases.\(^{(35)}\) Polyphenols obtained from the diet are known to inhibit the free radical production derived from xenobiotic toxic agents, thus reducing the risk of liver disease.\(^{(35)}\) Carotenoids are photosynthetic pigments that provide much of the different colors seen in plants and constitute an important part of the diet of many animals. In humans, carotenoids-enriched diets...
have been linked to prevention of certain cancers and eye diseases.\(^{(38)}\) As FPP, peels, PPP and syrup presented different effects in our in vitro and ex vivo assays, we evaluated the differences between the content of phenolic compounds and carotenoids in these products.

We performed a determination of the total phenolic content of the peach-derived samples by the Folin–Ciocalteau method and observed a higher content of total phenolics in peels and FPP compared to PPP and syrup, we used the gallic acid as standard (Fig. 6A). In a previous study with this same variety (Maciel) of peach, chlorogenic acid was found to be present in high amounts in lyophilized samples from the whole fruit.\(^{(28)}\) Chlorogenic acid is one of the most abundant polyphenols in fruits and it may be one of the main phenolic compounds exerting the biological activities observed here. We also performed a quantification of five common carotenoid compounds (all-trans-lutein, zeaxanthin, β-cryptoxanthin, α-carotene and β-carotene) in these samples by HPLC (Fig. 6B). Both FPP and peel presented higher concentrations of all carotenoids evaluated, while the PPP samples presented lower levels of these compounds with exception of α-carotene, which was not detected. On the other hand, there were no detectable amounts of any of the carotenoids analyzed in syrup samples. In previous studies, it was observed that peach peels exhibited a 2 to 27-fold higher antioxidant activity than the fruit pulps.\(^{(39)}\) In general, the main differences between these fruit parts are the richest protein content of peels and the higher carbohydrate content in the pulp.\(^{(40)}\) However, as we have seen here, the amount of carotenoids and phenolic compounds between these fruit parts may differ.

High concentration of phenolic compounds has been correlated with higher antioxidant activity in dietary fruits such as strawberry, raspberry, blueberry, peach, apricot and pear.\(^{(41)}\) However, isolated phenolic compounds, carotenoids and vitamins with known antioxidant properties (such as vitamin A) are not able to exert antioxidant and anti-inflammatory actions at the same level as when obtained from fruit extracts such as nectarine, peach and plum, which suggests an important role for the synergism among the antioxidants in the mixture.\(^{(42)}\) It is fairly possible that other molecules present in the samples studied here can also account for the biological effects observed in the present work. These include tocopherols (vitamin E), ascorbate, vitamin D, flavonoids other secondary metabolites. We observed here a rough correlation

Fig. 4. Effects of FPP, peel, PPP and syrup on biomolecule oxidative damage. Kidney, liver and brain cortex slices were pre-incubated with FPP, peel, PPP or syrup (80 μg/ml each) for 60 min and then subjected to oxidative damage by incubation with FeSO\(_4\) 1 mM and H\(_2\)O\(_2\) 100 mM for 30 min (stress-induced group). Tissues were homogenized and analyzed for (A), (B), (C) protein carbonylation, reduced sulphydryl content and TBARS content in kidney. The same assays were conducted to liver (D), (E), (F) and brain cortex (G), (H), (I). *Different from control group (p<0.05), #different from stress-induced group (p<0.05) using one-way ANOVA (Tukey’s post hoc). Values in graphic bars represent mean ± SEM (triplicate experiments, n = 6 per group).
between some of the biological effects exerted by different peach-derived samples and their content of phenolic compounds and carotenoids in samples. However, we cannot rule out the role of other compounds in such effects, particularly as we used an aqueous system to resuspend lyophilized samples, thus enhancing the bioavailability of compounds other than carotenoids. Carotenoids are hydrophobic compounds and their bioavailability is highly dependent on the solubility properties of their environment. It is very likely that the effects observed here would vary if peach samples had been subjected to extraction methods using apolar solvents, which would increase the availability of carotenoids to tissue slices. However, in this work we had as major aim not to perform a search for active compounds in peaches, but to explore the potential biological activities of peaches and its derivate products in the form they are consumed by humans. Thus, the use of extraction methods specific for hydrophobic compounds would therefore alter their bioavailability in relation to their form of consumption. With this in mind, we chosen the lyophilization of samples followed by water ressupension as in pilot experiments this has proven the most suitable form of administrating equal

![Fig. 5. Effects of FPP, peel, PPP and syrup on interleukin release. Kidney, liver and brain cortex slices were pre-incubated with FPP, peel, PPP or syrup (80 μg/ml each) for 60 min and then subjected to oxidative damage by incubation with FeSO4 1 mM and H2O2 100 mM for 30 min (stress-induced group). The incubation medium was collected and analyzed by ELISA. (A) TNF-α of kidney, (C) liver and (E) brain cortex was quantified. IL1-β levels in (B) kidney, (D) liver and (F) brain cortex were evaluated too. *Different from control group (p<0.0001), #different from stress-induced group (p<0.05) using one-way ANOVA (Tukey’s post hoc). Values in graphic bars represent mean ± SEM (triplicate experiments, n = 6 per group).](image)

![Fig. 6. Total phenol content and HPLC quantification. (A) Suspensions of FPP, peel, PPP and syrup (100 μg/ml) were analyzed for total phenolic content. Values are expressed in μg of gallic acid equivalents per gram of dry weight of samples (DW). ***Different from syrup and PPP groups (p<0.0001), *different from syrup group (p<0.05). B) HPLC quantification of major carotenoids in FPP, peel, PPP and syrup samples. Values are expressed in μg of each compound per 100 g of lyophilized sample. Letters denote same degree of significance between groups for each carotenoid (p<0.05), *different from all other groups. Values in graphic bars represent mean ± SEM (triplicate experiments, n = 3 per group).](image)
amounts of sample (considering their dry weight) in a system (aqueous) with physiological significance. Thus, it is not surprising that we have detected the presence of hydrophobic compounds such as carotenoids in these water-based suspensions, as the same happens in all fruit juices where hydrophobic-derived compounds are readily detectable and present a significant bioavailability after ingestion.

Conclusions

FPP, peels, PPP and syrup present different antioxidant, anti-glycation and anti-inflammatory properties, as assessed by in vitro and ex vivo assays. The assessment of antioxidant and anti-inflammatory effects in liver, kidney and brain cortex slices showed significant differences between the peach-derived products; FPP and peel presented the highest antioxidant and anti-inflammatory properties, followed by PPP. Syrup had no significant effect in all assays. We observed that the content of phenolic compounds and carotenoids is significantly higher in FPP and peels, followed by PPP, and a low levels of phenolic compounds plus undetectable levels of carotenoids in syrup. Further studies will address the effects of the consumption of these products derived from peaches in vivo models, as well as the role of the micronutrients and their effects.

Authors’ Contributions

J.G. conducted all the animal studies and drafted the manuscript. N.S., K.K., performed oxidative stress assays. R.C.B., performed assays of total phenolic content, protein glycation and total reactive antioxidant potential. K.S.M., conducted High-Performance Liquid Chromatography (HPLC) assays. C.S.G. and T.K.R., performed oxidative damage assays. M.S.M. was responsible by ELISA assays. M.V. and M.C.B.R. performed peach production, collection and lyophilization. J.C.F.M. and D.P.G. supervised and coordinate this work. All authors have read and approved the final manuscript.

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Abbreviations

CAT catalase
FeSO4 ferrous sulfate
FPP fresh poulp peach
H2O2 hydrogen peroxide
IL-1β interleukin-1 beta
LDH lactate dehydrogenase
PBS phosphate buffer saline
PPP preserve poulp peach
RAGE receptor for advanced glycation endproducts
SH sulfhydryl
SOD superoxide dismutase
TBARS thiobarbituric acid reactive species
TNF-α tumor necrosis factor alpha

Conflict of Interest

No potential conflicts of interest were disclosed.

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