Short communication: Influence of pasteurization on the active compounds in medicinal plants to be used in dairy products

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ABSTRACT

Interest from the dairy industry in adding herbal drugs to milk and yogurt products raises the question of whether these plant materials can be pasteurized. Root material of *Rhodiola rosea*, *Eleutherococcus senticosus*, and *Panax ginseng*, all plants with adaptogenic activities, was pasteurized. The content of active compounds in the root material before and after pasteurization was quantified by HPLC analysis. The results show that the eleutherosides in *E. senticosus*, and to an extent the ginsenosides from *P. ginseng*, could withstand pasteurization, whereas salidroside and rosavin from *R. rosea* did not survive pasteurization. Thus, *R. rosea* is not suitable for products requiring pasteurization.

Key words: *Eleutherococcus senticosus*, *Panax ginseng*, pasteurization, *Rhodiola rosea*

Producers in the dairy industry would like to introduce milk and yogurt products with beneficial health properties. Of interest are performance- and immune-boosting products that could contain plant material from adaptogenic plant species. Species such as Russian root (*Eleutherococcus senticosus*), ginseng root (*Panax ginseng*), and Arctic root (*Rhodiola rosea*) are well-known adaptogenic plants (Darbinyan et al., 2000; Davydov and Krikorian, 2000; ESCOP, 2003; Shvetsov et al., 2003; Persson et al., 2004; Panossian and Wagner, 2005; Reay et al., 2006). *Panax ginseng* contains a series of ginsenosides and *E. senticosus* several eleutherosides to which the adaptogenic activity is attributed. Both species are included in the European Pharmacopoeia (2008), where the monographs include quantitative assessment of the 2 groups of compounds. *Rhodiola rosea* contains salidroside, tyrosol, and rosavins, which are presumed to be the active compounds.

Before plant material can be added to a milk-based product, it needs to be pasteurized. For practical reasons, it is most convenient to pasteurize the plant material separately before addition to the milk-based product, as is done with fruit. The heating process could influence the composition of the active substances in the immune-boosting plants. Previous studies on the effects of pasteurization have dealt mainly with the visual quality of the plant material, such as the color stability of fruit and vegetable additions (Vasquez et al., 2007; Gössinger et al., 2009a,b), but also with the antioxidant activity in tomatoes (Dede et al., 2007). One study investigated the effect of pasteurization on the antioxidant effect of the medicinal plant *Echinacea purpurea* (Chen et al., 2009). In the present study, we investigated the effect of pasteurization of the plant material on the concentration of the active compounds.

Root materials of *Eleutherococcus senticosus* Maxim (Araliaceae) and *Panax ginseng* C.A. Meyer (Araliaceae) were purchased from Natur Drogeriet (Hørning, Denmark). Roots of *Rhodiola rosea* L. (Crassulaceae) were collected from a cultivated field in Falster, Denmark, and dried at 40°C. All root materials were ground to a powder.

For pasteurization, powdered root material was suspended in water (1:10 wt/vol) at 95°C and kept at this temperature for 4 min. The mixture was cooled to room temperature in an ice bath. The plant material was separated from the water phase by suction filtration. The plant material was dried at 37°C for 24 h, and the water phase was lyophilized. Pasteurized and nonpasteurized root material of *E. senticosus* was processed according to the assay in the European Pharmacopoeia (2008) monograph for *Eleutherococci radix*. The lyophilized water phase from the pasteurization of *E. senticosus* was redissolved in 50% ethanol and filtered through a 0.45-μm nylon filter. Pasteurized and nonpasteurized root material of *P. ginseng* was processed according to the assay in the European Pharmacopoeia monograph for *Panax radix* (European Pharmacopoeia, 2008). The lyophilized water phase from the pasteurization of *P. ginseng* was redis-
solved in 20% acetonitrile and filtered through a 0.45-
μm nylon filter.

One hundred milligrams each of pasteurized and non-
pasteurized material of *R. rhodiola* was extracted with
3 mL of extraction solution (methanol:dichloromethane
1:3, containing 0.4 mg/mL salicin as internal standard)
for 60 min in an ultrasound bath. The extract was
centrifuged and 2 mL of supernatant transferred to a
new vial. Two milliliters of the extraction solution was
added to the plant material and the extraction process
repeated. The plant material was extracted 3 times
in total, resulting in 6 mL of supernatant, which was
taken to dryness under vacuum. The extract was redis-
solved in 1 mL of 50% methanol and filtered through a
0.45-μm nylon filter. The lyophilized water phase from
the pasteurization of *R. rhodiola* was redissolved in 50%
methanol and filtered through a 0.45-μm nylon filter.

All pasteurization and extraction procedures were
performed twice. Quantitative analysis of the eleutheroside
content in the extracts from *E. senticosus* was carried out
during the procedure in the European Pharmacopoeia (2008) utilizing a Waters HPLC
apparatus (Waters, Milford, MA) with a Waters 1525
pump system and a photodiode array detector (Waters
2996) equipped with a Phenomenex Luna 5-μm C18
250 × 4.6 mm column (Phenomenex, Torrance, CA).
Quantitative analysis of the ginsenoside content in the extracts from *P. ginseng* was carried out according to
the procedure in the European Pharmacopoeia (2008)
utilizing a Shimadzu HPLC apparatus (Kyoto, Japan)
with a Shimadzu FCV 10AL pump system connected
to a Shimadzu SPD-10 AV detector and equipped with Nucleosil 5-μm C18 125 × 4.6 mm column (Macherey-
Nagel GmbH and Co. KG, Düren, Germany). Quantita-
tive analysis of salidroside and rosavin was carried out
on a Shimadzu SPD-6AV HPLC apparatus equipped with a Phenomenex Luna 5-μm C18 150 × 4.6 mm
column. The oven temperature was 40°C. Elution was
carried out with gradient elution with A (acetonitrile
5%) and B (methanol 50%) as follows: time 0 to 10 min
with eluent B 0 to 66%, time 10 to 12 min eluent B 66
to 100%, time 12 to 15 min 100% eluent B. The flow
rate was 1 mL/min; detection was carried out at 221
nm. All determinations were done in duplicate.

Pasteurization of *E. senticosus* root material did not
lead to a destruction of the eleutherosides, but the com-
pounds were found in the water phase (Table 1). This
means that either the entire pasteurization mixture
should be used or adding the extract rather than the
plant material should be considered. After pasteuriza-
tion of *P. ginseng* root, ginsenosides were found in both
the plant material and the water phase (Table 2). The
combined ginsenosides in the pasteurization mixture
constituted 72% of the ginsenosides found in nonpas-
teurized root material. The pasteurization of *R. rosea*
root let to a loss of more than 80% of salidroside and
90% of rosavin (Table 3); what remained of the two
compounds was found in the water phase.

The results show that Russian root, *E. senticosus*, can
be pasteurized without loss of the active compounds,
and ginseng root, *P. ginseng*, can withstand pasteuriza-
tion with loss of about 25% of the active compounds.
Both of these roots are suitable for preparations that
involve pasteurization. On the other hand, the presumed
active compounds in Arctic root, *R. rosea*, could not
withstand the pasteurization procedure; thus, *R. rosea*
not a candidate for addition to dairy products. These
results highlight that plant materials with beneficial ef-
facts cannot simply be added to dairy products because
the pasteurization process may destroy the effects of
the plants.

<table>
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<tr>
<th>Sample</th>
<th>Eleutheroside B</th>
<th>Eleutheroside E</th>
<th>Total eleutherosides</th>
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<tbody>
<tr>
<td>Nonpasteurized plant material</td>
<td>0.035</td>
<td>0.010</td>
<td>0.045</td>
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<tr>
<td>Pasteurized plant material</td>
<td>0.002</td>
<td>0.017</td>
<td>0.019</td>
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<tr>
<td>Water phase from pasteurization</td>
<td>0.034</td>
<td>0.010</td>
<td>0.044</td>
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<table>
<thead>
<tr>
<th>Sample</th>
<th>Ginsenoside Rg 1</th>
<th>Ginsenoside Rb 1</th>
<th>Total ginsenosides</th>
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<tbody>
<tr>
<td>Nonpasteurized material</td>
<td>0.222</td>
<td>0.473</td>
<td>0.695</td>
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<td>Pasteurized material</td>
<td>0.042</td>
<td>0.275</td>
<td>0.317</td>
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<td>Water phase from pasteurization</td>
<td>0.084</td>
<td>0.092</td>
<td>0.176</td>
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<table>
<thead>
<tr>
<th>Sample</th>
<th>Salidroside</th>
<th>Rosavin</th>
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<tr>
<td>Nonpasteurized material</td>
<td>0.396</td>
<td>1.663</td>
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<tr>
<td>Pasteurized material</td>
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<td>0.008</td>
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<td>Water phase from pasteurization</td>
<td>0.078</td>
<td>0.131</td>
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REFERENCES


