

Degradation and epimerization of wheat ergot alkaloids during French baking test

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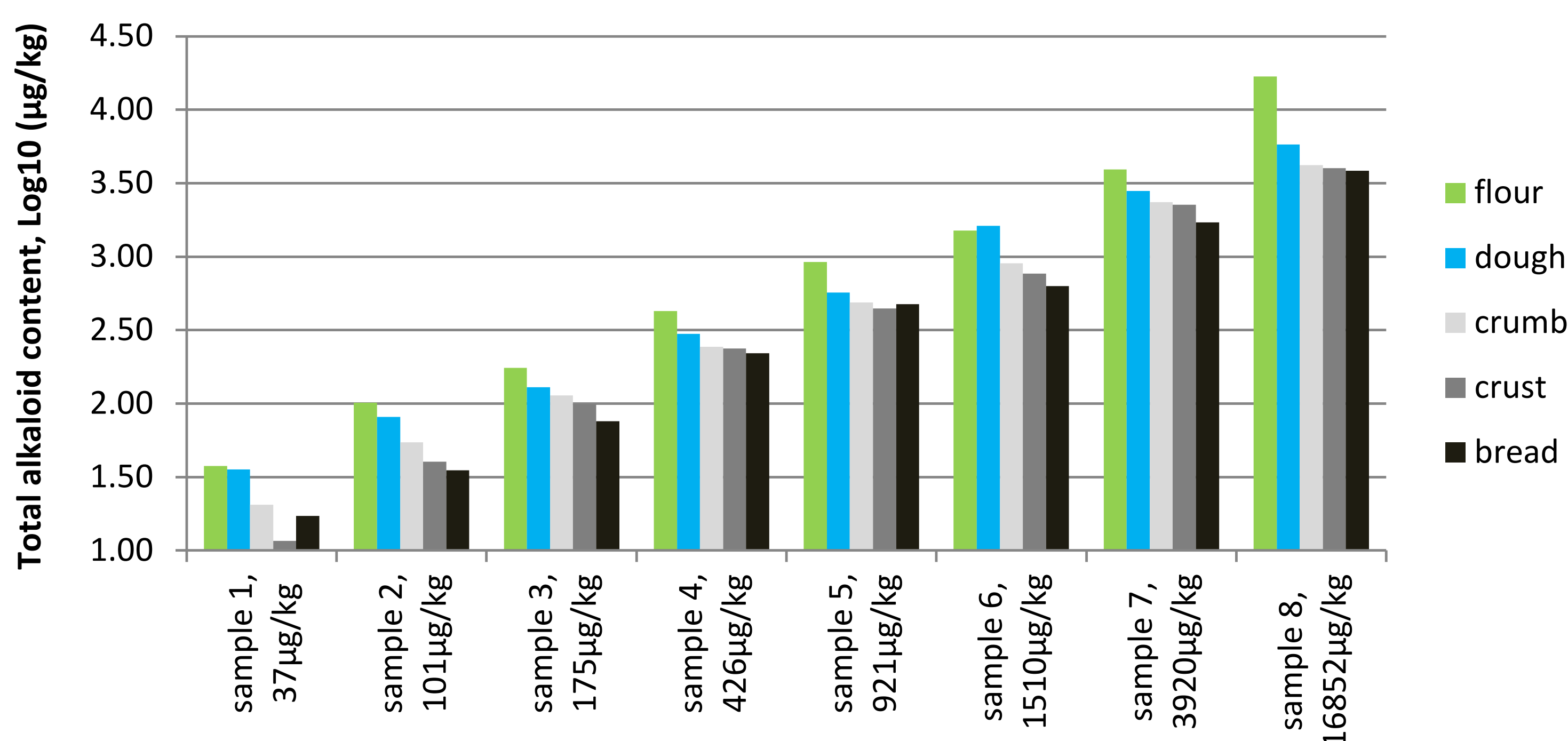
AIM OF THE STUDY

With increasing reports of ergot sclerotia detection on cereal grains in EU, regulation (EC) No 1881/2006 has recently been amended to set a maximum level of ergot sclerotia in unprocessed cereals at 0.5g/kg for human consumption. The presence of Ergot sclerotia is regularly reported in national survey in France. For this reason growers and users pay particular attention to this question. To better understand what occurs during food processing ARVALIS studied the become of ergot and alkaloids during the French baking test.

RESULTS

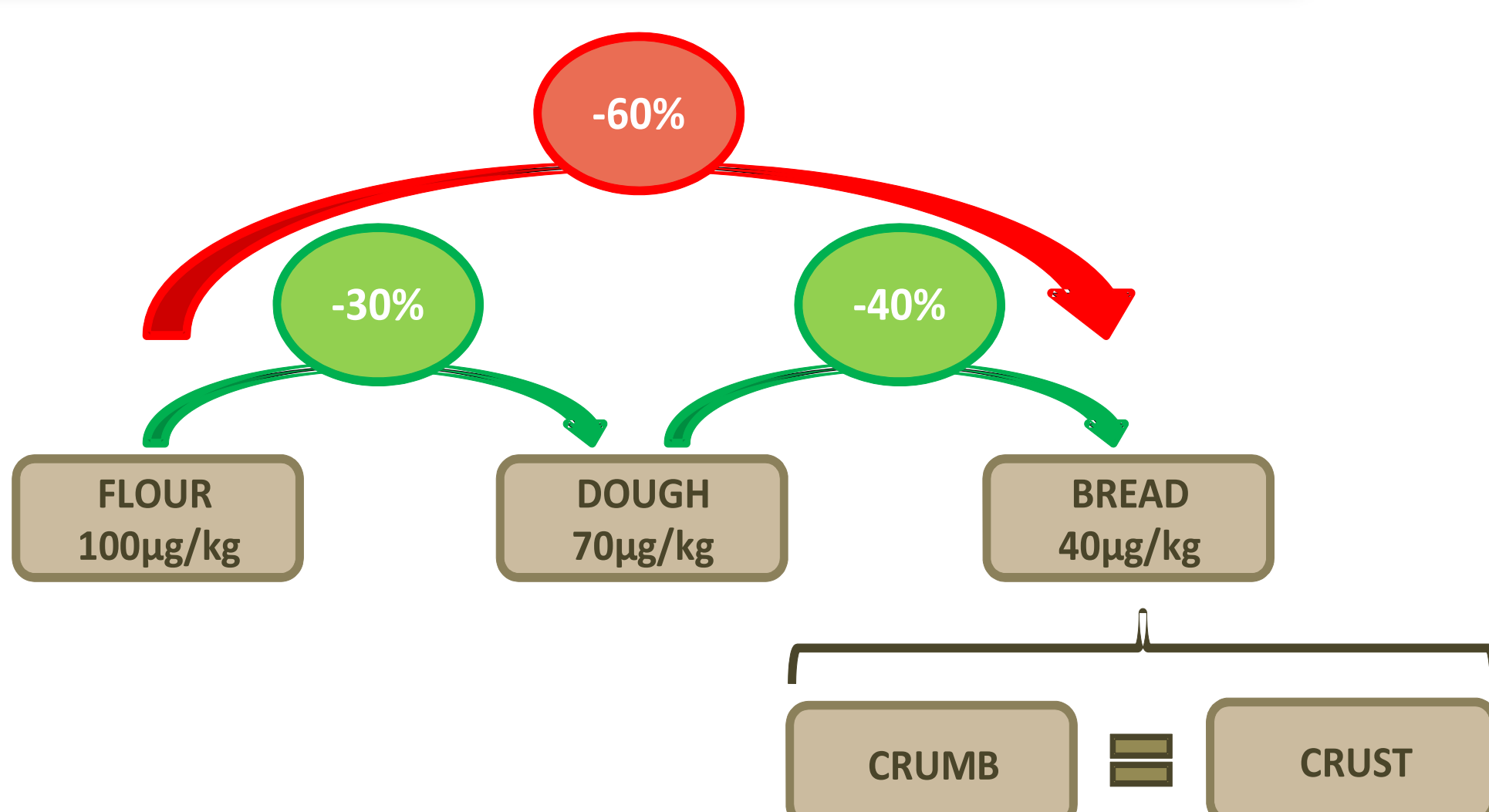
A first reduction of the total alkaloid content occurs from flour to dough. It is about 30% and is related to a dilution effect of the 900ml of water added to the 1500g of flour when kneading. The cooking stage leads to reduce by 40% the total alkaloid content in the bread compared to dough. This reduction rate is similar for each sample and not dependant on the initial alkaloid rate in flour (Fig. 1). As a result of the food processing the total alkaloid level in bread was 59% lower than flour in our study.

Fig. 1 Total alkaloid content in dough, crumb, crust and bread according to flour alkaloid content of the 8 contaminated samples.



The toxicologically relevant (*R*)-epimers are in majority in the flour for the 6 alkaloids but the ratio of (*R*) to (*S*)-forms differs for each alkaloid (Fig. 2). The mean ratio for the 8 samples is 4.0 for ergotamine in flour and 2.5 for ergocornine. Regarding the degradation rate it is also variable according to the alkaloid. In this experiment ergotamine was more lowered whereas ergometrine was more stable. The epimerization increased with the temperature as shown by the decrease of the (*R*)- to (*S*)-epimer ratio from dough to crust (Fig. 3).

CONCLUSION



As a conclusion, flour could be detoxified during the French baking test by both epimerization and degradation of ergot alkaloids. The total alkaloid content in bread was reduced by 60% from the flour content whatever the alkaloid concentration was. Ergometrine is more stable and ergotamine is more lowered during the process involving that analysis of each alkaloid separately has to be considered to assess toxicological risk. Better understanding the epimerization phenomenon should also be more investigated.

Références

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- Merkel S., Dib B, Maul R., Köppen R., Koch M., Nehls I. (2012). Degradation and epimerization of ergot alkaloids after baking and in vitro digestion. *Anal Bioanal Chem* 404:2489-2497.
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MATERIAL & METHODS

A sclerotia grinding containing 3.0 mg/g alkaloids was added to a commercial wheat flour ("Corde Noire"). 8 mixes were produced to obtain contaminated flour in a range of concentration for alkaloid from 60 µg/kg to 15000 µg/kg. A French baking test was performed at ARVALIS laboratory according to the standard method NF V03-716. The hydration rate is about 60% and cooking temperature is 250°C. Alkaloid content was determined by means of LC-MS/MS at UGhent Laboratory of Food Analysis in dough and bread after cooking and separately in crumb and crust.

Fig. 2 Alkaloid content in flour, dough and bread for the flour sample contaminated with 921µg/kg alkaloids.

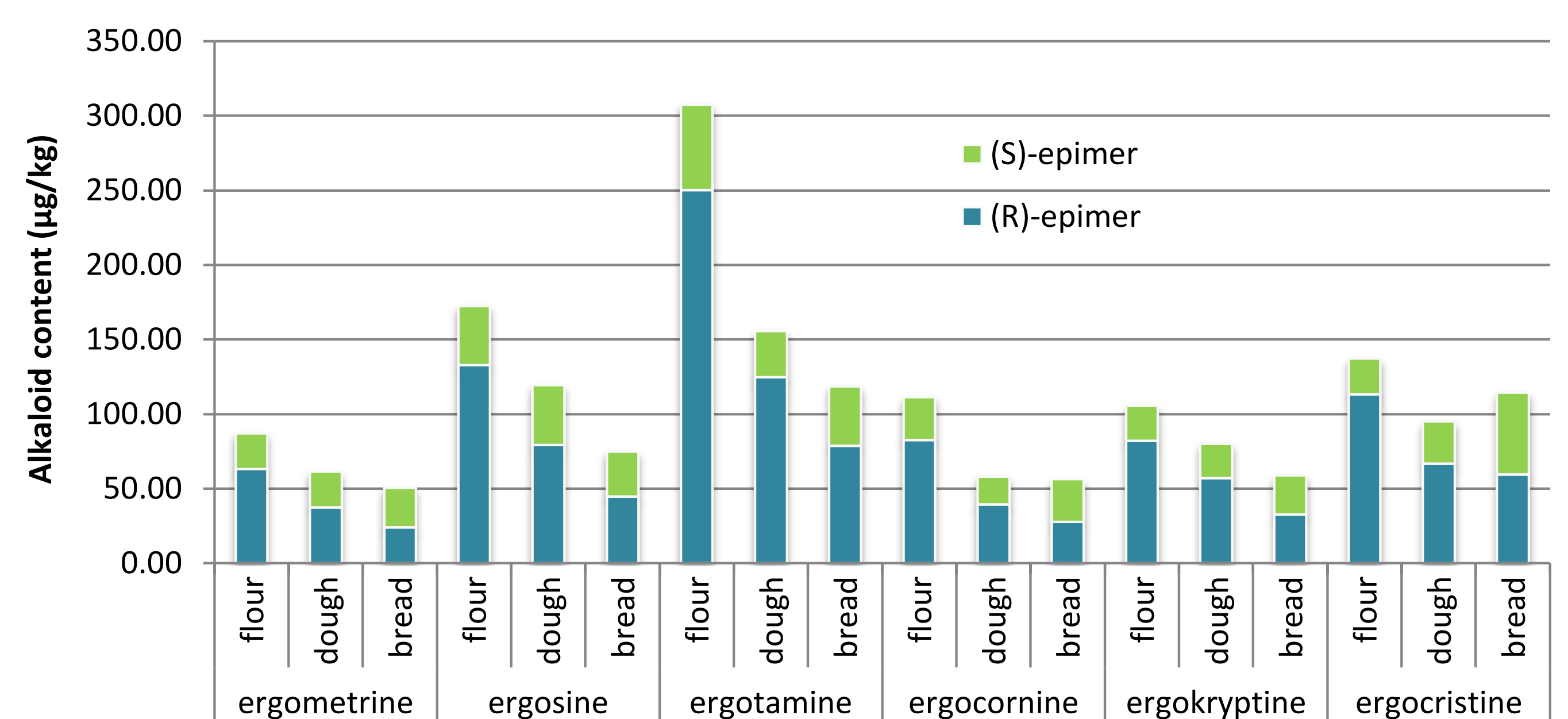


Fig. 3 Evolution of the ratio of (*R*) to (*S*)-epimers for the total alkaloid content (mean of the 8 samples).