International Journal of Food Microbiology 266 (2018) 79–86

Contents lists available at ScienceDirect

International Journal of Food Microbiology

journal homepage: www.elsevier.com/locate/ijfoodmicro

Influence of fermentation and other processing steps on the folate content of a traditional African cereal-based fermented food

Fabien Saubade, Youna M. Hemery, Isabelle Rochette, Jean-Pierre Guyot, Christèle Humblot*

Institute of Research for Development (IRD), UMR 204 Food and Nutrition Research in the Global South (NUTRIPASS), IRD/University of Montpellier/SupAgro, Montpellier, France

ARTICLE INFO

Keywords:
Pennisetum glaucum
Nutrition
Lactic acid fermentation
Yeast
African food
Vitamin B9

ABSTRACT

Folate deficiency can cause a number of diseases including neural tube defects and megaloblastic anemia, and still occurs in both developed and developing countries. Cereal-based food products are staple foods in many countries, and may therefore be useful sources of folate. The production of folate by microorganisms has been demonstrated in some cereal-based fermented foods, but has never been studied in a traditional African cereal based food spontaneously fermented. The microbiota of *ben-saalga*, a pearl-millet based fermented porridge frequently consumed in Burkina Faso, has a good genetic potential for the synthesis of folate, but the folate content of *ben-saalga* is rather low, suggesting that folate is lost during the different processing steps. The aim of this study was therefore to monitor changes in folate content during the different steps of preparing *ben-saalga*, from pearl-millet grains to porridge. Traditional processing involves seven different steps: washing, soaking, grinding, kneading, sieving, (spontaneous) fermentation, and cooking. Two type of porridge were prepared, one using a process adapted from the traditional process, the other a modified process based on fermentation by backslopping. Dry matter and total folate contents were measured at each step, and a mass balance assessment was performed to follow folate losses and gains. Folate production was observed during the soaking of pearl-millet grains (+ 26% to + 79%), but the folate content of sieved batters (2.5 to 3.4 μg/100 g fresh weight) was drastically lower than that of milled soaked grains (17.3 to 19.4 μg/100 g FW). The final folate content of the porridges was very low (1.5 to 2.4 μg/100 g FW). The fermentation had no significant impact on folate content, whatever the duration and the process used. This study led to a better understanding of the impact on folate of the different processing steps involved in the preparation of *ben-saalga*.

1. Introduction

Cereal-based food products are staple foods in both developed countries and low- and middle-income countries in many parts of the world (FAO, 1995; FAOSTAT, 2011). In West Africa in 2011, cereal-based food products were the main contributors to the energy supply (FAOSTAT, 2011). In West Africa, many cereal-based foods made from maize, sorghum or millet are fermented (Guyot, 2012). Indeed, fermentation is an ancestral way of preserving food products that increases their sanitary and nutritional quality (Nout, 2009). Fermentation is also often considered as a good way to increase the vitamin B content of food products, as yeasts and many lactic acid bacteria (LAB) responsible for fermentation can also synthesize vitamin B9 (folate) *de novo* (LeBlanc et al., 2011; Moslehi-Jenabian et al., 2010; Saubade et al., 2017a).

Folate is present in non-negligible amounts in cereal grains (from 29 to 143 μg/100 g fresh weight (FW) basis) (Giordano et al., 2016; Souci et al., 2000; Stadlmayr et al., 2012). Folate deficiency leads to many pathologies, including neural tube defects, megaloblastic anemia and colorectal cancer (Bailey et al., 2015; FAO/WHO, 2005; Liew, 2016). Folate deficiency is still a global health concern, as it has been recorded in both developed and low- and middle-income countries, and on all five continents (McLean et al., 2008; Viñas et al., 2011; Youngblood et al., 2013).

The production of folate by microorganisms in fermented dairy products has been extensively studied, see reviews by LeBlanc et al. (2008) and Saubade et al. (2017a), but only a few studies have been conducted on the production of folate in cereal-based fermented foods (CBFFs). Most of these studies focused on the use of folate-producing yeasts to increase the folate content of this category of food (Hjortmo et al., 2008a, 2008b). But among bacteria isolated from cereals or pseudo cereals such as pearl-millet or quinoa, some were able to produce folate in culture medium (Carrizo et al., 2016; Greppi et al., 2017a; Salvucci et al., 2016). Fermentation can increase the folate

* Corresponding author.
E-mail address: christele.humblot@ird.fr (C. Humblot).

https://doi.org/10.1016/j.ijfoodmicro.2017.11.015
Received 8 June 2017; Received in revised form 8 November 2017; Accepted 20 November 2017
Available online 22 November 2017
0168-1605/

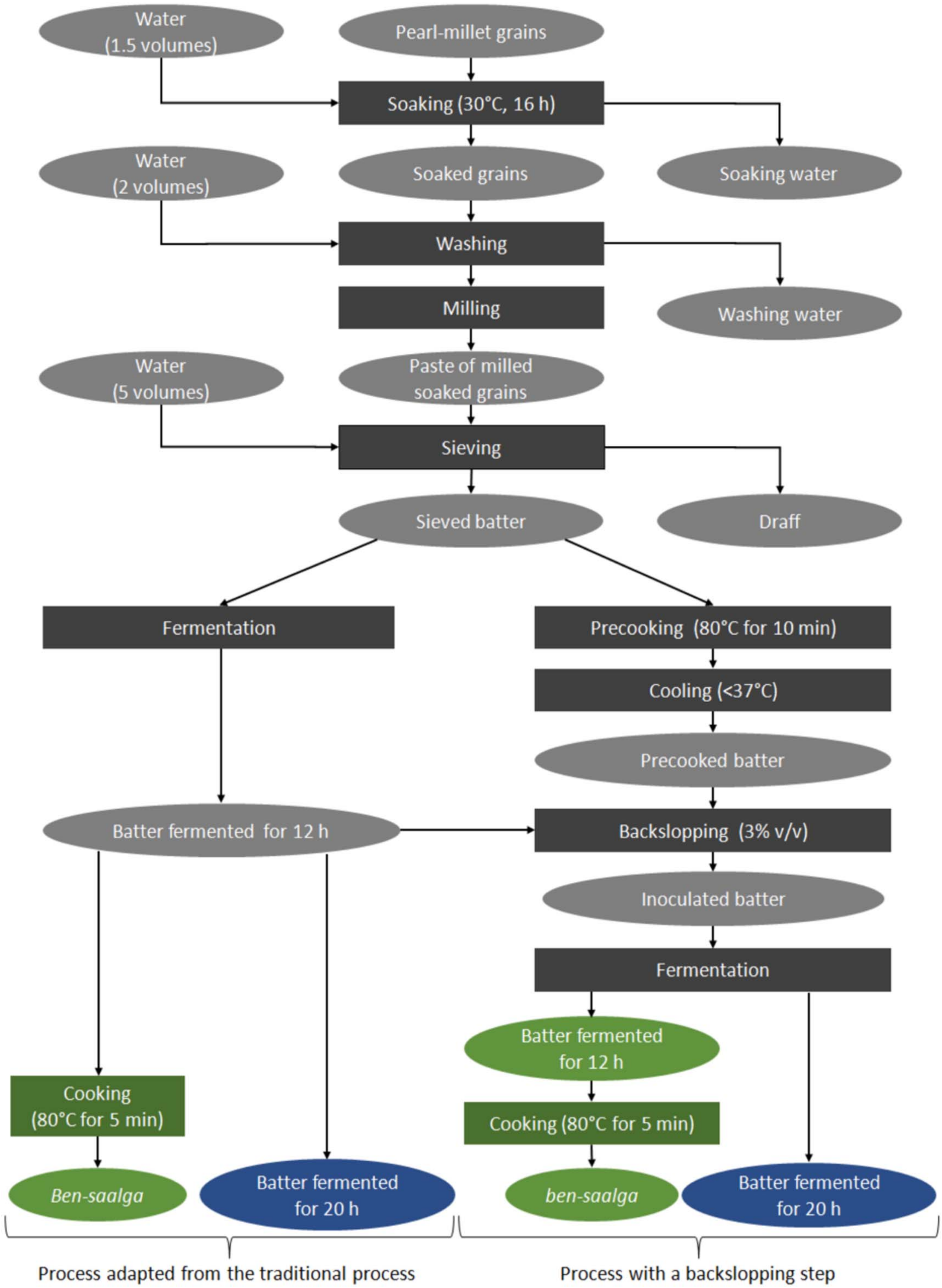

Fig. 1. Processing of pearl-millet into *ben-saalga* according to a process adapted from the traditional process with spontaneous fermentation (SF) and another process including a backslopping step (BI). Steps only included in the first set of experiments are in green, and steps only included in the second set of experiments (influence of the duration of fermentation) are in blue. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

content of cereal based fermented foods by 700% (Hjortmo et al., 2008b).

Ben-saalga, a pearl-millet based fermented porridge widely consumed in Burkina Faso, is frequently used as a complementary food for infants and young children (Mouquet-Rivier et al., 2008). Mouquet-Rivier et al. (2008) assessed that 66% of the households in Ouagadougou can be considered as “consumers” of pearl-millet based porridges and that 69% of the children under the age of two in those households consumed it every day. The genetic potential for various nutritional functions of the microbiota in *ben-saalga* was studied by Turpin et al. (2011). This study showed that the LAB isolated from *ben-saalga* have a good genetic potential for the synthesis of folate, since both genes *folP* and *folK*, which encode enzymes involved in folate synthesis, were detected in 96% of the strains tested. In addition, this