# Processing of various adjuncts in beer production

## Raw grain adjuncts – Sugars and sugar syrups – Malt substitutes

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Published by VLB Berlin

Die Deutsche Bibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data is available in the Internet at dnb.ddb.de

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1. English Edition 2013

Translated by Mike Burbidge, Berlin

ISBN-13: 978-3-921690-74-1

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## Contents

# Abbreviations

| | |
|---|---|
| AAL | Apparent attenuation limit |
| ADF | Apparent degree of fermentation |
| as is | air-dry condition |
| BC | Before Christus |
| CCV | Cylindroconical vessel |
| cG2 | Maltose concentration |
| DE | Dextrose equivalent |
| DP | Diastatic power |
| ED | Extract difference (Fine/coarse) |
| $E_{452}$ | Extinction value in a 1 cm cuvette at 452 nm |
| d.m. | In dry matter |
| FAN | Free alpha-amino nitrogen |
| FAO/WHO | Food and Agriculture Organization of the World Health Organization |
| FCC | Food chemicals codex |
| $F_{pase}$ | Filter paper saccharifying activity |
| GDR | German Democratic Republic (1949 - 1990) |
| GT | Gelatinization temperature |
| ISPP | Industrial scale pilot plant |
| IU | International enzyme units |
| JECFA | Joint FAO/WHO Expert Committee on Food Additives |
| M | Mole mass in Dalton (Da) |
| MF | Malt fraction |
| MEV | Malt equivalent value |
| OG | Original gravity |
| PW | Pitching wort |
| RBA | Raw barley adjuncts |
| RDF | Real degree of fermentation |
| TU | Tyrosine units |
| U | Units |
| $v_{max}$ | Maximum rate of reaction |
| YB | Young beer |
| | |
| °WK | Degrees Windisch-Kolbach |

**Abbreviations for statistical analyses**

| | |
|---|---|
| $R^2$ | Coefficient of determination |
| multiple $R^2$ | Coefficient of determination for multiple regression and correlation analysis |
| n | Number of test series |
| * | Result with 95 % confidence limits |
| ** | Result with 99 % confidence limits |
| *** | Result with 99.9 % confidence limits |

# Preface

With the title “Raw Materials, Technologies and Techniques for the Processing of Various Adjuncts in Beer Production”, the authors wish to present a short history of the use of raw grain adjuncts and inform about the present situation.

Alongside an explanation of the important terms, the focus is on the main adjuncts corn (maize), rice and barley and the peculiarities associated with their processing but also on millet/sorghum, wheat, rye, oats, triticale, manioc as well as starch syrups and other sugar products. The use of whey and potatoes is also dealt with.

The enzymes relevant for the digestion of adjuncts are outlined and the handling of enzyme preparations explained.

The technical equipment for the preparation and processing of the adjuncts, especially the mechanical crushing and grinding techniques, are presented.

Key topics in the text are, above all, the mashing process and suggestions for wort production using raw grain adjuncts in the brewery. Emphasis is given to the processing of raw barley.

Finally, quality aspects of the beers and economic considerations of adjunct use are discussed.

The results presented are based on the long term experiences of the authors with the use of adjuncts in the brewing industry of the former GDR and their accompanying scientific support.

The accumulated knowledge could also be of assistance in the future to secure the extract base for the international brewing industry.

The authors wish to express their thanks to Mr. *Mike Burbidge* for translating the text and to the VLB Berlin for publishing it.

Berlin, August 2013

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