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主食へのおからの有効利用に関する調理科学的研究

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豆腐の製造工程で排出されるおからは、年間 70 万トン以上にも達し、産業廃棄物として扱われ、環境汚染が懸念されている。しかし、おからには、一般に不足しやすい、食物繊維が豊富に含まれ、積極的に利用されることが望まれる。従来の研究では、主菜や菓子類の報告が多く、毎食、喫食されるものではないために、おからの消費増加と食物繊維の摂取増加にはつながっていない。このような背景から、本研究では、おからの消費増加と食物繊維の摂取増加が期待できる主食を対象とした。

試料とするおからには、凍結乾燥させた粉末おからを用いた。女子大学生のパネルによって官能評価を行い、各主食製品の受容度を明らかにした。また、製品特性については、画像解析、色調および物性測定により検討した。

飯では、1%添加まで受け入れられた。2%以上では、飯表面に付着する粉末おからが、ざらつき感を与え、受容されなかった。パンでは、小麦粉のうち 5%および 10%の置換が受け入れられた。5%では、対照と同等のやわらかさとなり、10%では、やや硬くなった。麺では、10%の置換が受け入れられた。

これらの結果をもとに、製造元の異なる 2 種類の市販おから粉末を用いて、その適用性を検討したが、2 種類のおから粉末は、飯、パン、麺のいずれにも適用できた。但し、一方のおから粉末では、成分組成や粒度の影響があると思われ、10%の置換のパンは、よい評価が得られなかった。麺への適性は 2 種類のおから粉末とも良好で、10%以上の置換も期待された。このように、取扱いが簡便な市販おから粉末が主食に利用することが可能となり、家庭や大量調理施設での利用による、おからの消費増加と食物繊維の摂取増加が期待された。

以上の結果を実際の食生活に活かすと、各主食の 1 食分をご飯 180 g、食パン 60 g、茹麺 200 g としたとき、おからを添加した各主食の食物繊維量は、ご飯では 0.4 g、パンでは 1~2 g、麺では 3 g 増加し、各主食を 1 日で摂取した場合、5 g 前後の増加が期待された。平成 21 年国民健康栄養調査によると、食物繊維量は成人の場合、男性で 3.9 g、女性で 2.3 g 目標量に不足しているが、本研究によるおから添加のご飯、パン、麺の三食で、その目標量が達成できる。このように、本研究の成果を活用すれば、環境保全ばかりではなく、健康にも大きく寄与できると思われた。

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Cookery studies on the utilization of okara in daily meals

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The amount of okara created in the tofu manufacturing process is not less than 700,000 tons per year in Japan and a large portion of this okara is treated as industrial waste that can cause environmental pollution. On the other hand, the consumption of okara is strongly recommended because it is rich in dietary fiber and the intake of dietary fiber tends to be insufficient. So far, many attempts have been reported concerning main or side dishes or confectionery containing okara as an ingredient. However, these have not contributed much either to the increase in the consumption of okara or to an increase in the intake of dietary fiber, since they are not eaten at every meal. In order to enjoy the nutritional and environmental benefits of the consumption of okara, daily meals containing a regular amount of okara should be devised. In the present study, the inclusion of okara into staple foods, such as boiled rice, bread and udon, was tried to attain a daily intake of okara, and then the acceptability of the products was evaluated by a panel of female students. The physical properties of the products; the surface structure, color and the texture were also assessed.

Okara was used in the form of freeze-dried powder. Boiled rice containing up to 1% okara was acceptable. Products containing more than 2% okara were not accepted due to the coarse surface texture caused by adhering okara powder. Bread with the replacement of flour with 5% and 10% okara was acceptable. The products with 5% replacement were as soft in texture as controls without replacement but the 10% replacement gave a little harder texture. In the case of udon, 10% replacement was acceptable.

Based on the results obtained above, the applicability of okara powder obtained from two manufacturers was tested; one was available in the market and another was a product for food industry manufactured by a soybean oil company. As a result, both manufactured okara powders were also applicable to boiled rice, bread and udon as was the lab-made powder. However, bread with 10% replacement with one of the manufactured powders was not acceptable, probably due to the chemical composition and the particle size. The compatibility of the manufactured powders with udon was excellent and it is suggested that more than 10% replacement should be applicable. The applicability of the manufactured powders shown here should make the utilization of okara easy at home or by large-scale meal providers and consequently increase both the consumption of okara and the intake of dietary fiber.

One cup, 180 g, of the boiled rice added with 1% okara, a piece of sliced bread, 60 g, with 5% to 10% replacement and a 200 g portion of udon, with 10% replacement should additionally contain 0.4 g, 1 to 2 g and 3 g of dietary fiber, respectively. If each of the products containing okara were eaten once a day, around 5 g of increase in the intake of dietary fiber could be expected. According to the National Health and Nutrition Survey in Japan, 2009, the intake of dietary fiber in male and female adults is insufficient by 3.9 g and 2.3 g, respectively, for the tentative Japanese goals for preventing life-style related diseases, suggesting that the goals could be easily reached by eating the three products every day. Thus, the products developed here should greatly contribute not only to environmental preservation but also to health.