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Note on the Attenuation and Desilication of Egyptian Rice Hulls

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Proper mechanical and chemical treatment methods were applied to rice hulls with view to secure their use as animal foodstuff. The nutritive value of the hulls, which is out of the scope of this investigation, was not tackled.

Application of proper milling means has provided for the attenuation of the hulls.

A combination of mechanical and chemical treatment methods proved satisfactory for the desilicating of the hulls, thus, attaining relatively lower silica rates. Silica in one sample-treated in this way was diminished to as low as about 8% compared with 19% silica originally found in the corresponding untreated hulls.

In Egypt, more than 200,000 tons of rice hulls are byproduced as a waste in rice mills. This amount is liable to increase in the future as a result of the progressive expansion in rice cultivation after the construction of the High Dam at Aswan has been completed.

Trials were made in this country to make use of this agricultural waste material to suit various purposes. Badr *et al.* (1965) and Abdel Maksoud *et al.* (1970).

The hulls are structurally characterised by their acicular habit and high silica content, which would exhibit their tough nature; silica in the Egyptian rice hulls ranges between 20 and 25%. The nutritive value of the rice hulls is too low to use the latter alone as animal food-stuff, especially that they are deficient in protein Abou Ria *et al.* (1970). In order to increase their nutritive value, they need a chemical treatment, e.g., ammoniation or treatment with urea ... etc., to be enriched with nitrogen. However, the use of the hulls as filler to replace a part (about 25%) of the wheat straw in animal food is problematic due to their acicular habit and high silica content as just mentioned. Again, the digestible portion of silica in the hulls would cause formation of renal calculus in the animal. Moreover, the hulls possess an acicular habit a nature by which they would be harmful to the digestive system of the ruminants, unless the hulls be attenuated. Trials were made to attenuate the hulls with the purpose to use them as an animal foodstuff through the application of proper grinding means (4) Fahmy *et al.* (in press). However, the reported data (Badr *et al.*, 1965) of silica equilibria in sheep fed for

months on a green fodder, blended with ground rice hulls, showed that the non-excreted part of silica reached 5%. This percent, per se, is not low enough to neglect, especially that such a digestible part of SiO_2 would be integrally magnified in breeds which may be fed for longer intervals on such a foodstuff.

One of the objectives of the present investigation aims at bringing about a proper mechanical means of grinding the hulls to attain attenuation. The attenuated hulls are additionally exposed to an adequate chemical treatment to attain proper desilication. By the attenuating and desilicating the rice hulls thier utilization as filler in animal food would be secured, and the hulls can be blended in higher ratios.

Materials

1. Fresh sample of the Egyptian rice hulls provided by a local rice mill, SiO_2 in this sample reaches 19%.

2. Commercially-produced hydrated lime (effective CaO equals 58.2%), used in the form of lime milk for chemical treatment of the hulls.

Experimental

A successive group of experiments, through which the rice hulls were exposed to various mechanical disintegration and chemical treatment, were performed. These aim at providing proper conditions for the attenuation and desilication of the hulls.

Gyratory Milling of the Hulls

A sample of the fresh hulls was disintegrated through being ground in a proper laboratory gyratory mill to attain a particulate state.

Treatment with Lime

The hulls, in their natural state, were washed with tap water to eliminate any contamination like dust or mud balls.

The clean sample was soaked in lime milk for complete one day. Another sample of the hulls, in the disintegrated state, was treated with lime in he same manner as mentioned before.

Disintegrability of the Lime-Treated Hulls by Birollers Milling

A sample of the lime-soaked hulls, in the natural state, after discarding the excess lime, was passed between birolls of a laboratory small-sized birollers mill consisting of a couple of steel rolls which move against each other. The one and the same sample was passed between the double-rollers for ten cycles.

Steaming of the Lime-treated Hulls

Three samples, which are non-disintegrated, gyratory-milled and birollers-milled hulls, were autoclaved at 1 atm for 1 hr consequent to lime treatment. The combined action of disintegration (birollers milling) lime-treatment and prolonged autoclaving was also investigated. In this way, samples were exposed to steam treatment at 2½ atm for 1, 3 and 5 hr.

Ashing of the Hulls

The differently treated samples were washed with water till the wash water gives passive basicity reaction in order to secure removal of lime traces. The samples were therefore dried and ignited at 1000°C in an oxidizing atmosphere till completee decarbonization. However, SiO_2 determinations were taken as a judgement of the desilicating of the treated hulls,

Results and Discussion

Effect of Mechanical Disintegration on the Attenuation of the Hulls

Milling in gyratory mills gives rise to particulate hulls which are bran-like material.

The volume of the gyratory-milled hulls is much reduced compared with the non-disintegrated hulls. However the lime-treated birollers-mil'ed hulls are in the form of weakened flakes. The birollers-milled hulls occupy about one fourth the volume occupied by the non-disintegrated hulls. In as much as the birollers-milled hulls attain weakening, they readily imbibe water when soaked in the latter and settle at the bottom of the container thus the non-disintegrated hulls would float at the surface and could be advantageously isolated.

Desilication of the hulls

The silica contents determined in the differently treated hulls are shown in Table 1. It is obvious that more soaking of the hulls, in their natural state in lime milk has not the least effect on their desilication. However gyratory milling of the hulls prior to lime treatment has an indifferent action in this respect. Birollers milling instead of gyratory milling has not further influence on the desilication of the hulls providing similar conditions of lime treatment. Furthermore, steam treatment at 1 atm has but a little effect on the desilication of disintegrated lime-treated hulls. In contradistinction, steaming of the latter at a relatively higher atmosphere (2½ atms.) has proved very effective as regards the desilicating of the hulls. At one and the same atmosphere, 2½ atm., prolonged steaming of the previously treated hulls has not contributed significantly to the desilication of the latter.

TABLE 1. Silica contents of the differently-treated Rice Hulls

Type of treatment	Silica contents (weight percent)
Untreated	19.1
Soaked in lime milk	19.0
Gyratory-milled and lime-treated	18.0
Lime-treated and birollers-milled	18.1
Lime-treated, birollers-milled and autoclaved at 1 atm for 1 hr.	17.6
Lime-treated, birollers-milled and autoclaved at 2½ atm for 1 hr.	9.9
Cyratory-milled, lime-treated and autoclaved at 2½ atm for 3 hr.	13 0
Lime-treated, birollers-milled and autoclaved at 2½ atm for 3 hr.	10.7
Gyratory-milled, lime-treated and autoclaved at 2½ atm for 5hr.	14.0
Lime-treated, birollers-milled and autoclaved at 2½ atm for 5 hr.	8 5

The magnitude of desilication differs notably with the different methods of disintegration applied to the hulls ; i.e., gyratory milling or birollers milling, prior to lime treatment and steaming at 2½ atm. Birollers milling distinctly proved much more effective in this regard.

It could be concluded that lower silica rates would be optimally expected on applying severer chemical and steaming conditions using caustic materials and higher atmosphere a case which is worthy further investigation.

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نبـذة عن ترقيق وازالة السليـكا من قشـور الأرز المصرى (رجيع الكون) :

محمد عبد المقصود
المركز القومى للبحوث .

لقد طبقت طرق ميكانيكية وكيماوية مناسبة على قشور الارز (رجيع الكون) بغرض امكانية استعماله كغذاء للحيوان مع ملاحظة أن القيمة الغذائية لها لم تدرس فى هذا البحث لخروجها عن مجاله .

ولقد أمكن الوصول الى ترقيق قشور الأرز وذلك باستعمال وسائل طحن مناسبة لذلك .

وقد ثبت مناسـبة اسـتعمال طـرق تجمع بين المعاملات الكيماوية والميكانيكية لازالة السليكا مما أدى الى الوصول الى معدلات سـليكا منخفضة نسبيا فى قشور الأرز وللمقارنة وجد أن نسبة السليكا فى عينة معاملة قد قلت الى نسبة منخفضة تصل حوالى ٨٪ بينمـا هى ١٩٪ فى العينة المماثلة غير المعاملة .