STUDIES ON NIOIGOME I. ON THE COMPOSITION OF NIOIGOME (PERFUMED RICE)

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I. ON THE COMPOSITION OF NIOIGOMÉ (PERFUMED RICE)*

By

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A few years ago, we received Nioigomé from a friend who lived at the foot of Mt. Kurikoma in the northern part of Miyagi Prefecture. As it is said that when common rice was boiled with it, the rice becomes tasty and sweet-smelling, so we adapted it as a first step of our study on rice.

Collecting the stories on Nioigomé from many specialists of rice culture and actual producers of this rice, it may be said that there are no detailed description about the variety name, method of cultivation or utilization of this rice except a note on "Kotohin" in the "Food crops, detailed argument" by Kikkawa (1). It is only cultivated traditionally by the local farmers for festivals all over the country, and does not belong to a fixed variety.

Nioigomé has a few by-names, "Jakômai" according to its nice smell, "Soshûmai" because of its similarity of smell to that of urine of rat, "Akawase" for the red colour of its unhulled rice and stem. According to the old people of Miyagi Prefecture the name would be from an archaic word "Iwaga" (In Japanese, it means to celebrate).

As known from the derivation of the word, this rice is mainly offered to the spirit of their ancestors on thanksgiving day. So it is necessary to be precocious, and for it, there is another name Nioiwase. It is said that Nioigomé begins to smell even at the young stage of two or three inches height in the rice nursery. Its smell is strongest in the season of flowering, and when they boil the rice, it can be smelled out from a distance of 100 yards and its taste is nice.

Fertilizing to this rice commonly tends to cause a disease and prostration, so it is cultivated without fertilizer regardless of the yield decrease of about 20 per cent. Nioigomé is a kind of nonglutinous rice, hulling and polishing of this rice is difficult, the stem is long and it is suitable for processed goods of straw.

* The original Japanese report was published in the Hakkô Kôgaku Zasshi **35**, 22–26 (1957).

In the north district of Miyagi Prefecture, it is cultivated by five or six families in each village, and the area used for it is about one-thirteenth or one-eighth of an acre in general and the broadest one is one-fourth of an acre. They preserve the seeds traditionally and exchange them with one another.

Now concerning the real utilization of Nioigomé, Nagashima who is the chief of the brewing laboratory in Fukushima Prefecture used this rice for brewing saké, but he could not succeed to brew the characteristic saké.

We now report on the analyses of two kinds of Nioigomé produced in Miyagi Prefecture and one in Akita Prefecture, and the common rice cultivated by the same farmer, analyses of vitamin B_1, analyses of water soluble constituent and paper chromatography (PPC) of sugars.

Experimental

I. Analyses of Nioigomé and common rice.

Nioigomé (hulled rice and milled rice) and common rice (hulled rice) harvested in 1954 on the same farm (Kitakatamura, Miyagi Prefecture) and Nioigomé (hulled rice) and common rice (hulled rice) harvested in 1954 on the same farm (Minamikatamura, Miyagi Prefecture) and Nioigomé (milled rice, Daigomura, Akita Prefecture) were analysed.

Nioigomé and common rice were crushed and sorted out with a 40 mesh screen and analysed. Analyses were carried out according to the methods described in "Jikken Nôgei kagaku", Tôkyô University. The results are shown in Table 1.

Table 1. Composition of Nioigomé and common rice.

	Harvest year	Moisture %	Crude starch %	Crude protein %	Crude fat %	Crude fiber %	Crude ash %
Nioigomé (hulled rice) (Miyagi Kitakata)	1954	15.82	65.26	8.26	2.46	1.40	1.44
in dry matter		—	77.52	9.81	2.92	1.66	1.71
Common rice (hulled rice) (Miyagi Kitakata)	1954	15.44	67.31	7.52	2.44	1.40	1.45
in dry matter		—	79.60	8.89	2.89	1.66	1.71
Nioigomé (milled rice) (Miyagi Kitakata)	1953	15.28	74.84	5.67	0.18	0.19	0.48
in dry matter		—	88.34	6.69	0.21	0.22	0.57
Nioigomé (hulled rice) (Miyagi Minamikata)	1954	17.47	64.78	8.42	2.35	1.53	1.43
in dry matter		—	78.49	10.20	2.85	1.85	1.73
Common rice (hulled rice) (Miyagi Minamikata)	1954	16.96	66.19	7.75	2.52	1.29	1.33
in dry matter		—	79.71	9.33	3.03	1.57	1.60
Nioigomé (milled rice) (Akita Dâigo)	1956	14.61	72.45	10.53	0.97	0.30	0.79
in dry matter		—	84.85	12.33	1.14	0.35	0.93

As shown in Table 1, there was no great difference between the Nioigomé and the common rice, but the amount of crude protein in the Nioigomé was about one per cent larger than that of the common rice and the amount of starch was less than that of the common rice.

II. Analyses of vitamin B_1.

The vitamin B_1 in the Nioigomé and common rice were determined by the Diazo method. The results are shown in Table 2.

Table 2. Vitamin B_1 content of Nioigomé and common rice.

	Harvest year	Before boiling γ/100 g	After boiling γ/100 g	Loss %
Nioigomé (hulled rice) (Miyagi Kitakata)	1955	427	213	50.1
Nioigomé (hulled rice) (Miyagi Kitakata)	1954	272		
Common rice (hulled rice) (Miyagi Kitakata)	1954	243	118	51.4
Nioigomé (milled rice) (Miyagi Kitakata)	1953	30		
Nioigomé (milled rice) (Akita Dâigo)	1956	104 (Diazo method) (2) 107 (Thiochrom method)		

The results of Table 2 indicates that the vitamin B_1 content in the Nioigomé was a little larger than that of common rice. The decomposition of vitamin B_1 in the Nioigomé and common rice by boiling was estimated. The decomposition ratio in Nioigomé and common rice was about 50 per cent.

III. Analyses of water soluble constituents of Nioigomé and common rice.

The water soluble constituents of Nioigomé and common rice were analysed. The results are shown in Table 3.

Analytical methods were as follows. Total sugar: after heating with 2.27 per cent HCl on the boiling water bath for 2.5 hours and neutralization with NaOH, it was determined by Bertrand-Henmi method (calculated as glucose); total invert sugar: after heating with 0.1 per cent HCl on the boiling water bath for 30 minutes followed by neutralization with NaOH, it was determined by Bertrand-Henmi method (calculated as invert sugar); reducing sugar: Bertrand-Henmi method (calculated as glucose); the separative determination of glucose and fructose: Willstätter-Schudel method; sucrose: (total invert sugar minus reducing sugar) × 0.95; water soluble total nitrogen: Kjeldahl method; amino nitrogen: Soerensen-Formol titration method.

Table 3. Analyses of water soluble constituents of Nioigomé and common rice.

	Harvest year	Total sugar %	Total invert sugar %	Reducing sugar %	Glucose %	Fructose %	Sucrose %	Dextrin %	Water soluble total N %	Amino-N %
Nioigomé (hulled rice) (Miyagi Kitakata)	1954	2.61	2.23	1.83	1.67	0.16	0.33	0.70	0.16	0.025
in dry matter		3.10	2.65	2.18	1.98	0.19	0.39	0.83	0.19	0.030
Common rice (hulled rice) (Miyagi Kitakata)	1954	2.31	1.86	1.63	1.60	0.031	0.18	0.60	0.15	0.022
in dry matter		2.73	2.20	1.93	1.89	0.036	0.21	0.71	0.18	0.026
Nioigomé (milled rice) (Miyagi Kitakata)	1953	0.88	0.58	0.49	0.47	0.015	0.067	0.35	0.031	0.005
in dry matter		1.04	0.69	0.58	0.55	0.017	0.079	0.42	0.037	0.006
Nioigomé (hulled rice) (Miyagi Kitakata)	1955	2.72	2.21	1.53	1.39	0.14	0.60	1.07	—	—
in dry matter		3.19	2.59	1.80	1.63	0.16	0.70	1.26	—	—
Nioigomé (hulled rice) (Miyagi Minamikata)	1954	2.81	2.17	1.94	—	—	0.17	0.78	0.17	0.029
in dry matter		3.40	2.63	2.35	—	—	0.21	0.95	0.21	0.035
Common rice (hulled rice) (Miyagi Minamikata)	1954	2.22	1.80	1.61	—	—	0.13	0.55	0.18	0.030
in dry matter		2.67	2.17	1.94	—	—	0.16	0.62	0.22	0.036
Nioigomé (milled rice) (Akita Dâigo)	1956	2.32	1.78	1.40	1.33	0.07	0.36	0.83	0.071	0.011
in dry matter		2.72	2.08	1.64	1.56	0.08	0.42	0.97	0.083	0.013

As shown in Table 3, water soluble sugars (total sugar, total invert sugar, reducing sugar, glucose, fructose, sucrose) in the Nioigomé were somewhat larger than that of common rice. The main sugar in rice was glucose. The content of water soluble sugars and total nitrogen in the hulled rice were 3-5 fold of the milled rice.

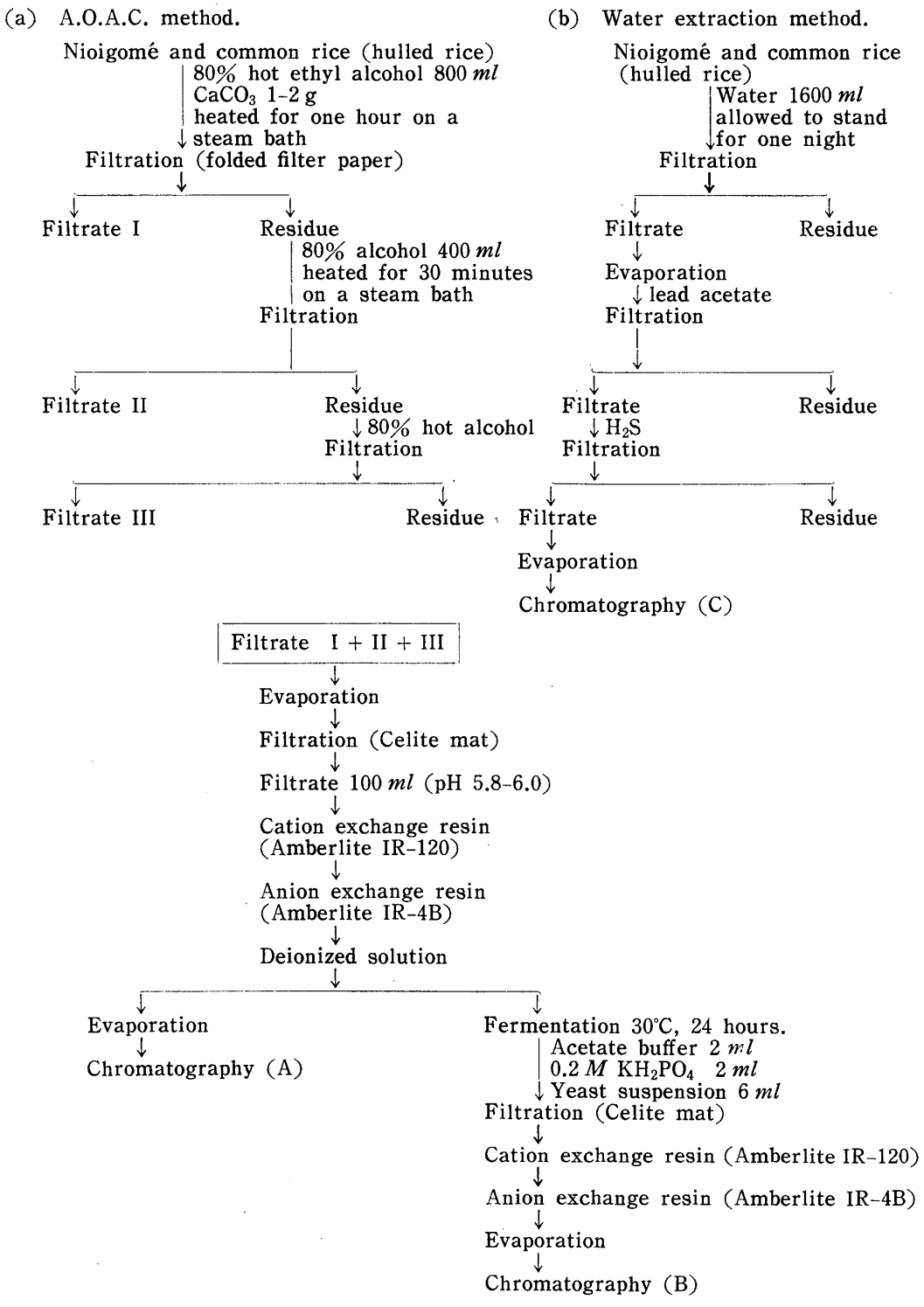
IV. PPC of sugars in Nioigomé and common rice.

PPC of sugars in Nioigomé and common rice harvested in Miyagi Prefecture was carried out.

Concerning the sugars in rice, Williams (3) has examined the sugar composition of 80 per cent ethanol extract of the rice produced in U.S.A. by PPC. Glucose, fructose, sucrose and raffinose were detected. Parihar (4) has reported that Indian rice was extracted with water and sugar composition was examined by circular PPC. Fructose, glucose, sucrose and raffinose were detected in almost all varieties of rice and glucose, fructose, galactose, sucrose, maltose, isomaltose, maltotriose and maltotetraose were detected in old samples.

Nioigomé and common rice were extracted with 80 per cent ethanol (A.O.A.C. method) (5) and water, respectively. The preparations of sugar solution are shown in Fig. 1 (a) and (b).

Fig. 1.



The sugar solution of Nioigomé and common rice were spotted on the Tôyo filter paper No. 2. After irrigating the chromatogram with pyridine-butanol-water (4:6:3), ascending three times, the sugars were located by spraying with aniline hydrogen phthalate and resorcinol reagents. The results are shown in Fig. 2—5.

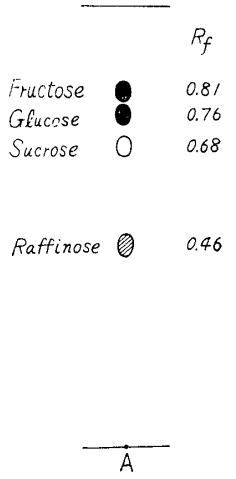


Fig. 2. Multiple paper chromatogram of sugars in rice (Nioigomé and common rice).
Spray reagent; A.H.P.
● intense ◍ middle ○ weak

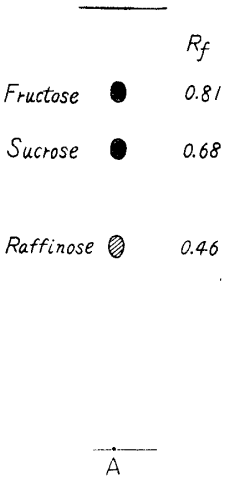


Fig. 3. Multiple paper chromatogram of sugars in rice (Nioigomé and common rice).
Spray reagent; Resorcin
● intense ◍ middle

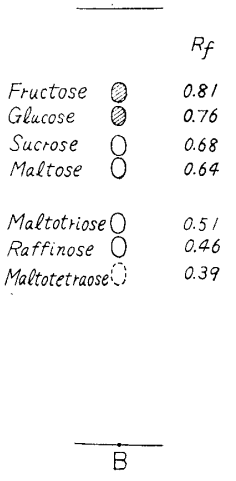


Fig. 4. Multiple paper chromatogram of sugars in rice (Nioigomé and common rice).
Spray reagent; A.H.P.
◍ middle ○ weak ◌ very weak

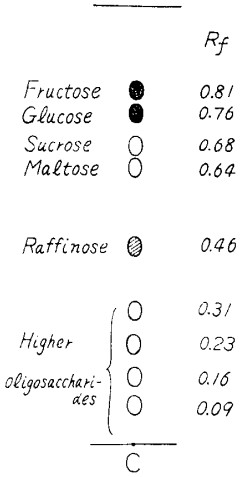


Fig. 5. Multiple paper chromatogram of sugars in rice (Nioigomé and common rice).
Spray reagent; A.H.P.
● intense ◍ middle ○ weak

As shown in Fig. 2—5, there was no difference in the sugar composition between the Nioigomé and common rice. The main sugars in Nioigomé and common rice were glucose, fructose, sucrose and raffinose. Moreover, a small

amount of maltose, maltotriose and maltotetraose were detected but galactose was not detected. Higher oligosaccharides were detected in water extract of rice but higher oligosaccharides were not detected in alcohol extract of rice.

Paper chromatography showed that new rice and one year stored rice gave the same sugar pattern, but on the paper chromatogram, maltose spot in the new rice was less conspicuous than that of the one year stored rice.

Summary

Using the Nioigomé and the common rice produced in Miyagi and Akita Prefectures, the composition and water soluble constituents were analysed and the paper chromatography of sugars was performed.

There was no great difference in the composition between the Nioigomé and the common rice harvested in the same farm, but the amounts of crude protein, water soluble sugars and vitamin B_1 in the Nioigomé were larger than those of the common rice and the amount of starch in the Nioigomé was less than that of the common rice.

On the paper chromatogram of the sugars of the Nioigomé and the common rice, seven spots corresponding to glucose, fructose, sucrose, raffinose, maltose, maltotriose and maltotetraose were detected. Moreover, four higher oligosaccharides were detected in the water extract of rice.

Paper chromatography showed that new rice and one year stored rice gave the same sugar pattern, but on the paper chromatogram, maltose spot in the new rice was less conspicuous than that of the one year stored rice.

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References

1) Kikkawa Y. (1925). Shokuyô Sakumotsu Kakuron.
2) Tôkyô University (1952). Jikken Nôgei Kagaku p. 126. Asakura Shoten, Tôkyô, Japan.
3) Williams, K.T. and A. Bevenue (1953). Cereal Chemistry **30**, 267.
4) Parihar, D.B. (1955). Nature **175**, 42.
5) Williams, K.T. and A. Bevenue (1953). A.O.A.C. **36**, 969.