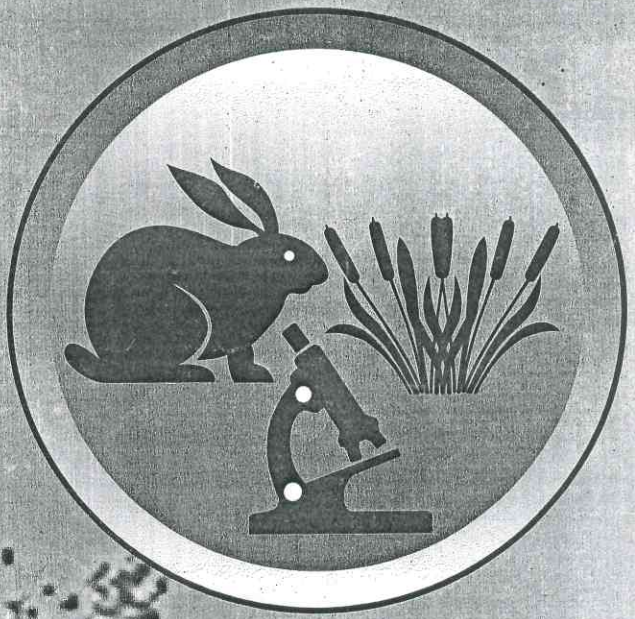
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EFFECT OF SUPERNATANTS OF VARIOUS CEREAL AND CEREAL MIXTURES ON YIELD AND ACCEPTABILITY OF SOFT CHEESE

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ABSTRACT
The study aimed at assessing the milk clotting activity, yield and acceptability of the West African soft cheese as affected by using three levels of the fermented supernatants of maize, sorghum, millet and their mixtures, used a 7*3 factorial design. The 7 Supernatants constituted the main factor, and the 3 levels (75, 100, and 125%) were the sub factor, all 21 treatments being replicated ten times. The results revealed that millet supernatant had the greatest milk clotting activity and sorghum supernatant had the least. Millet supernatant was highest in fibre and lowest in pH. The highest yield was obtained from 75 percent millet supernatant. Sensory values were high for maize/sorghum, maize and maize/millet supernatants while it was low for sorghum supernatant. It was thus concluded that 75 percent use of the supernatants, particularly maize, millet, maize/sorghum and maize/millet supernatants resulted in efficient coagulation of West African soft cheese.

Keywords: Cheese, Cereal, Supernatants, Coagulation, Yield, Sensory.

INTRODUCTION

Milk is an excellent source of nutrition, but is highly perishable (Biswas and Bhattacharyya, 2006). Processing of milk into cheese extends the shelf life appreciably (Belewu, 2006). As there are numerous Cheese types, in different parts of the world, various coagulants are in use for Cheese making. Calf rennet is universally acceptable and used. Its availability is however, limited. There are moreover recent trends towards vegetarianism, which necessitates the adoption of substitutes for calf rennet (Ogunleke, 2008). Various works have been carried out on the use of vegetable coagulants as substitutes for rennet, including pawpaw leaf extract and sodom apple juice (Tayo and Adeneye, 1997; Adetunji and Salawu, 2008), and lately, fermented Maize Supernatant (Onatola, 2004; Badmos and Joseph, 2012). The focus of this study is to determine the value, in terms of cheese yield and acceptability, of fermented Supernatants of commonly used cereal grains, as coagulants for West African Soft Cheese.

MATERIALS AND METHODS

Milk collection and handling: Fresh milk used for the experiment (25 litres) was collected from the lactating Fulani cows, at Bolorunduro settlement, adjacent to the University of Ilorin. The milk, sieved in a double layered cheese cloth, was taken in a plastic container, packed in an ice jacket, and transported to the Animal Production Laboratory of the University of Ilorin (latitude 08030' N and longitude 04035' E) for instant proximate analysis, pH determination, and Cheese production (Ogunleke *et al.*, 2008).

Preparation of cereal supernatants: The grains, as described below, soaked for 3 days, were washed thoroughly, milled, sieved, and left to stand for 6 hours (Badmos and Joseph 2012), after which a litre of the Supernatant was taken from:
M - Maize (10 kg), S – Sorghum (10 kg), T - Millet (10 kg), MS- Maize – (5kg) + Sorghum (5kg)
MT - Maize – (5kg) + Millet (5kg), TS - Sorghum – (5kg) + Millet (5kg),
MTS- Maize – (3.33kg) + Sorghum (3.33kg) + Millet (3.33kg)

Proximate composition of supernatants: The Proximate Composition of supernatants including the moisture content, the protein, the fat, the total ash and crude fibre were estimated for the various supernatants (AOAC, 1990).

Milk clotting activity of supernatants: The aqueous extract of various Cheese Coagulants were assayed for milk clotting activity assays by incubating 50 µl of the particular Coagulant with 500 µl of 100 mM sodium acetate buffer, pH 4.5, and 100 µl of 3 % fresh milk .The reaction volume was adjusted to 1 ml with distilled water. Assays were carried out at 37 °C for an hour and were stopped by the addition of 200 µl of 20 % (v/v) trichloroacetic acid. The precipitated protein was removed by centrifugation (10,000 x g for 5 min at room temperature) and absorbance of the supernatant was read at 366 nm (Dominguez and Cejudo, 1996). The result was obtained in three replicates.

Cheese coagulation by supernatants : Fresh cow milk (200 ml) was weighed, and put in an aluminium pot, which was put on a stove, and heated gently to 50 ^{0} C.

A quantity (150ml) of Maize Supernatant (75% of the milk) was also weighed and added into the pot with a pipette. The two weightings were added to give the Total Fluid Weight. The milk curdled with more heating after some minutes, as in the works of Onatola (2004), Ogunleke *et al.* (2008), as well as Badmos and Joseph (2012). The gentle heating of the curd continued for fifteen minutes, after which the heat source was removed and the cheese allowed cooling in the whey for thirty minutes. The cheese was ladled into a conical raffia basket, drained for five minutes and weighed. The weight of Cheese divided by the Total Fluid Weight gave the percentage Yield of Cheese. This procedure was replicated ten times for precision. The 20 other treatments were used in similar manner and the yield of coagulation was noted as well as the percentage yield.

Sensory evaluation: Thirty member trained panellists, consisting of University of Ilorin Students, were employed for the test. Cheese samples were placed in white plastic cups, labelled and placed on benches in a way that there was no interference between the panellists (Lammond, 1970; Badmos and Abdulsalam, 2012). Water was provided for the panellists to rinse their mouth after each taste. Evaluation was based on colour, taste, flavour, texture, and overall acceptability. Scores were based on hedonic scale of 1- 9 (1 = dislike extremely and 9 = like extremely).

Statistical analysis: The results obtained were subjected to analysis of variance using a 7x3 factorial Design, and the means compared by Duncan Multiple Range Test (Steel & Torrie, 1980).

RESULTS AND DISCUSSION

Proximate content of cereal supernatants: As shown in Table 1, the moisture content was numerically highest ($p>0.05$) for Sorghum/Millet Supernatant at 97.1% and least for maize/millet Supernatants at 96.7%. The Moisture content of 98.53% obtained in this study was lower than 99.2% obtained by Onatola (2004), possibly due to difference in efficiency of sieving, and the presence of floating fibre etc. The protein was highest for Sorghum Supernatant at 1.12%, and least for Millet Supernatant at 0.9%. The protein content of Millet Supernatant might be due to the protein content of Millet grain, which was reported as 11.50 % by Atteh (2002) compared to 11.0 % and 8.9 % respectively for Sorghum and Maize grains. Fat was highest for Maize Supernatant and Millet/Sorghum at 0.2%. Ash was low at 0.01 % for Millet Supernatant, while other Supernatants had 0.2 % ash. Fibre was high at 1.1% for millet and millet/sorghum, and lowest at 0.6 % for maize supernatant. Maize/millet and millet supernatants were low in pH at 5.35 and 5.45 respectively while pH of sorghum supernatant was relatively high at 6.25.

Table 1: Proximate Composition of cereal supernatants

Supernatants	Moisture	Protein	Fat	Ash	Fibre	pH
M	98.53	0.90^{c}	0.75^{c}	0.02^{b}	0.60^{a}	6.22^{e}
S	97.30	1.02^{e}	0.78^{a}	0.02^{b}	1.00^{d}	6.25^{e}
T	97.01	1.12^{a}	0.10^{a}	0.01^{a}	1.10^{e}	5.45^{b}
MS	96.90	1.00^{b}	0.20^{c}	0.02^{b}	0.70^{b}	5.50^{b}
MT	96.70	1.05^{d}	0.10^{a}	0.02^{b}	0.70^{b}	5.35^{a}
TS	97.10	1.05^{d}	0.10^{a}	0.02^{b}	1.10^{e}	5.71^{c}
MTS	96.80	1.00^{b}	0.15^{b}	0.02^{b}	0.90^{c}	6.02^{d}
SEM	**NS**	**±0.06**	**±0.05**	**±0.10**	**±0.37**	**±0.38**

Means followed by different Superscripts are significantly different, Note: M : Maize, S : Sorghum, T : Millet.
NS: Not statistically significant.

Milk clotting activity of cereal supernatants: As shown in Table 2, milk clotting activity was highest for Millet Supernatant at 30.56 units /ml, and lowest for Sorghum Supernatant at 4.03 units /ml. Maize/millet and maize supernatants were also high at 27.07 and 25.07 unit/ml. Maize/sorghum, sorghum/millet and maize/sorghum/millet supernatants were 14.05, 18.46, and 20.25 unit/ml respectively. The milk clotting activities trend is in line with the report of Okigbo *et al* (1985).

Table 2: Milk clotting activity of supernatants*

Supernatants	MCA
M	25.07 ± 1.44
S	4.03 ± 0.63
T	30.56 ± 1.58
MS	14.05 ± 1.15
MT	27.07 ± 1.49
TS	18.46 ± 1.26
MTS	20.25 ± 1.31

*Figures reported are mean values of five determinations, Note: M : Maize, S : Sorghum, T : Millet.

Cheese yield (gm) by supernatants: Table 3 showed that 75 % millet supported highest cheese yield at 46.23 gm per 200 ml milk coagulated and 125 % sorghum/millet supported lowest yield at 41.16 gm sorghum supernatant of 75 % did not coagulate cheese at all. There was tendency for high cheese yield at 75 percent coagulant use of all supernatant, as well as with use of millet and maize/millet supernatant. The high yield of millet and millet-based supernatants appear to be due to how pH and high milk clotting activity. Onatola (2004) obtained 19.50g cheese from coagulating 100ml maize/sorghum supernatant. This compares well with 42.74 gm per 200ml milk obtained in its study.

Table 3: Cheese yield (gm) by supernatants

	Levels			Supernatant Mean
Supernatants	**75%**	**100%**	**125%**	
M	43.63	42.73	41.73	42.70^{e}
S	0.00	41.65	39.29	26.98^{a}
T	46.23	45.18	44.15	45.19^{g}
MS	42.93	42.34	42.05	42.44^{d}
MT	44.48	43.73	42.63	43.61^{f}
TS	42.82	42.52	41.16	42.16^{b}
MTS	42.94	42.73	41.41	42.36^{c}
Level Mean	37.57^{r}	42.98^{t}	41.77^{s}	

S.E.M. ± 0.14

Means followed by different Superscripts are significantly different

Note: M : Maize, S : Sorghum, T : Millet.

Effect of supernatant on cheese yield (%): Table 4 shows that 75 % millet supernatant supported highest percent Cheese yield at 12.81 % yield, and 125 % Sorghum Supernatants supported least percent Cheese yield at 8.51 % yield. There is a general trend of high percentage yield with millet and millet based diets, as well as with 100 % level use of all supernatants. Percentage cheese yield is a factor of volume of fluid (milk + supernatant) coagulated. Larger volume of supernatant apparently leads to lowering percentage of cheese yield. High cheese yield (gm) can be the result of large volume of supernatant. The use of percentage Cheese yield is to differentiate the yield due to coagulant potency from that resulting from high volume of coagulating fluid. West African soft cheese contain over 60% moisture (Tayo and Adeneye, 1997; Badmos and Abdulsalam, 2012), and higher levels of supernatant use is expected to result in greater Cheese yield (gm). Mohammed *et al.*, (2010) however confirmed that higher levels of a coagulant did increase coagulation mass of cheese to an extent. This apparently is due to peak activity of microbial enzymes. 100% level of supernatant used in this work yielded effectively in weight and percentage. This work demonstrates that the yield of cheese gets to a peak between around 100 % Supernatant use. Coagulation with Supernatant use below 75% might have resulted in low yield, as in the work of Onatola (2004).

Table 4: Cheese yield (%) by supernatants

		Levels		
Supernatants	**75%**	**100%**	**125%**	**Supernatant Mean**
M	12.15	10.46	9.09	10.57^{c}
S	0.00	10.15	8.51	6.22^{a}
T	12.81	10.95	9.51	11.09^{e}
MS	11.88	10.25	9.05	10.39^{b}
MT	12.25	10.53	9.13	10.39^{b}
TS	11.89	10.34	8.91	10.38^{b}
MTS	11.83	10.29	8.87	10.38^{b}
	10.40^{s}	10.42^{s}	9.01^{r}	

SEM ± 0.11

Means followed by different Superscripts are significantly different

Note: M : Maize, S : Sorghum, T : Millet.

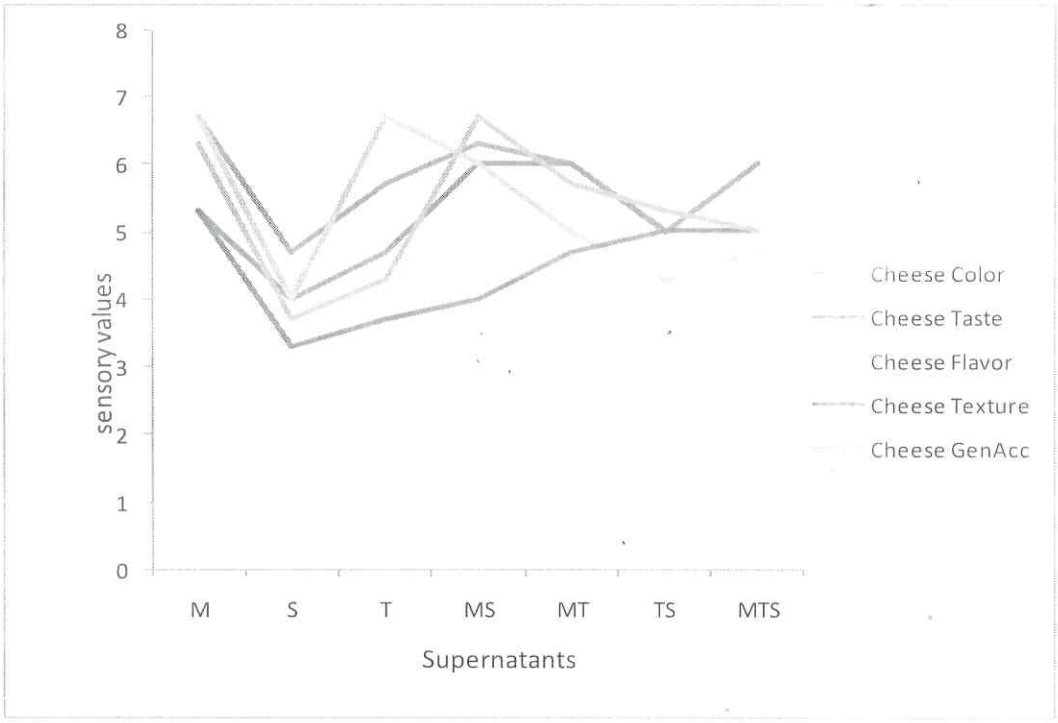


Figure 1: Cheese sensory values by various Supernatants
Note: M : Maize, S : Sorghum, T : Millet.

Cheese sensory values by supernatants: According to Figure 1, Cheese colour was highest for Maize/Sorghum, high for Maize, and poorly rated for Sorghum. Ayanniyi (2006) obtained 6.77 as colour rating of cheese using white sorghum supernatants. This compares well with 7 obtained for maize and sorghum supernatants cheese in this study. Cheese taste was also poorly rated for sorghum supernatant, but highly rated for maize/sorghum and maize/millet supernatants. Annongu (2012) asserted that tannins contained in sorghum seeds impart astringent tastes. This might have affected the cheese produced from sorghum supernatants. Flavour of ,maize and millet supernatant cheese were highly rated while sorghum/millet supernatant Cheese were poorly rated. Onatola (2004) reported flavour ranking of 3 for fourth day fermented maize supernatant. This is far lower than flavour rankings for all level of supernatant use in this study. The 3 days of supernatant fermentation is apparently the cause of lower flavour rating obtained by Onatola (2004). Texture was lowest for Sorghum Supernatant cheese but highest for maize supernatant. General acceptability was high for maize/sorghum, maize and maize/millet supernatants cheese in that order. The overall acceptability of 5.49 obtained by Ayanniyi (2006) for white sorghum supernatant is comparable to that obtained for red sorghum supernatant cheese in this study, but lower than the acceptability for maize supernatant cheese.

CONCLUSION AND RECOMMENDATION

It can be concluded from this study that Millet, Maize, Maize/Millet Supernatants supported relatively high Cheese yield (in that order), when used to coagulate milk at 75 % of the milk. Mean cheese sensory values were also high for maize/sorghum, maize and maize/millet supernatants. It is thus recommended that the four supernatants (maize, millet, maize/millet, maize/sorghum), be effectively used at 75 % as alternative coagulants for production of West African soft cheese.

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