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Research Paper :

Software model for figuring of ice cream mix

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ABSTRACT

Agro processing industries are receiving added significance in the new economic era. To cope up with the situation, industries are trying to modernize their operations by adopting the recent technological advances. Ice Cream industry is also trying to adjust the new environment by making appropriate modifications in their production and marketing structure. This paper develops an ice cream mix figuring computer aided program in C Language which is adaptable to any plant size. The logistics of the model is derived from the essentials of Linear Programming.

Key words : Serum Solids (SS), Skim Milk Powder (SMP), Computer Aided Design (CAD)

The prospects of any industry are decided by multiple factors such as selection of output, process, and distribution system and to a good extent promotion. The element "process" receives added significance because of fast growing technology. In olden days, the production process was mainly decided by primitive methods while in modern days, the indigenous methods are replaced by technology and even high tech. The high tech methods led to stiff competition, which reduce the competitiveness of manual methods. In this back drop, the necessity of computerisation in various phases of an industrial operation cannot be ignored. Now a days operations research analysts are frequently developing computer aided designs (CAD) to optimise their product planning. This corporate strategy is even adopted by small firms in which ice cream industry is also a component.

Agro processing industries have received added momentum in recent years because of the relatively high emphasis given for this sector under the liberalised regime. Agro processing sector tries to be competitive to match with new international entrants and the consequent threats. Agro processing covers a wide spectrum in which a prominent component is dairy processing and products.

The livestock sector plays a major role in the country providing employment and income to the farmer folk. To give added momentum to the sector, the Government of India launched operation flood in the year 1970 in three phases and it has been completed by the year 1995-96. The ripples of the flood spread to many parts of the country which led to the accumulated flow of milk. The excess supply of milk seasonally, compelled the farmers and the co-operatives to develop alternative strategies to utilise the excess milk. The thoughts suggested various alternatives such as Paneer, Burphy, Peda etc. Among the list, the most popular is ice Cream. Other than as a diversified product of milk, ice cream even reached the status of an after meal/dinner intake even in middle class families. Further, no ceremonies are left out without ice creams. These prospects of ice cream led to the mushroom growth of small or medium units and currently in their product line wide range of ice creams are included with varying flavours. . In 2007, the global market of ice creams was pegged at $61.6 billion in terms of retail value or 15 billion liters in terms of volume. Coming to India, the Indian ice cream industry is currently estimated to be worth Rs. 2,000 crores, growing at a rate of approximately 12%. The per capita consumption of ice cream in India is approximately 300 ml, as against the world average of 2.3 liters per annum (http://www.dare.co.in). Hence, an attempt is made to illustrate the application of computer softwares to decide the optimum ice cream mix.

METHODOLOGY

The Prevention of Food Adulteration (PFA) Rules, 1955 define ice cream as "a frozen product that contains not less than 10% milk fat, 3.5% protein, 36.0% total solids, and 0.5% permitted stabilizer and emulsifier." Players who deviate from these norms tactfully call their product "frozen dessert." However, it is illegal to sell "ice cream" which have contents below these specified standards.

Mathematical solution of ice cream mix:

Preparation of 100kg ice cream mix containing 10

per cent milk fat, 11 per cent serum solids, 14.5 per cent sugar and 0.3 per cent stabilizer.

Given whole milk testing 6.8 per cent fat and 9.6 per cent serum solids.

Cream testing 40.0 per cent fat and 5.4 per cent serum solids and

Skim milk powder testing 0.5 per cent fat and 97.0 per cent serum solids.

Let Whole milk required = X kg.
Cream required = Y kg.
Skim milk powder = Z kg.
Hence we can form the following equations

6.8X + 40Y + 0.5Z = 10.00 .....I (Fat equation)

9.6X + 5.4Y+97Z = 11.00.....II (Serum solids equation)

X+ Y+Z=100-14.5-0.3 III (Weight equation)

This can be written in the form AX=B

$$\begin{bmatrix} 6.8 & 40 & 0.5 \\ 9.6 & 5.4 & 97 \\ 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} 1000 \\ 1100 \\ 85.2 \end{bmatrix}$$

Now X= determinant (A1) / determinant (A)
Y= determinant (A2) / determinant (A)
Z= determinant (A3) / determinant (A)

Using the above method a computer software has been developed in C-language in which one has to input the required kilogram of ice cream, the required fat percentage, serum solids percentage, sugar percentage and stabilizer percentage of the mix. Also the user has to input the fat and serum solids percentage of milk, cream and skim milk powder in hand.

Variables used in the program:

A data structure one dimensional array is used to store A and B. The arrays in the program are named as mat, con, t and gmat. Temporary variables j, fm,sm,sg and ss are used to denote the required kg of ice cream, fat percentage of mix, serum solids percentage of mix, sugar percentage of mix and stabilizer percentage of mix, respectively.

mat[] is used to store A.

con[] is used to store B.

Location used	Purpose
mat[0]	Fat % of milk
mat[1]	Fat % of cream/butter
mat[2]	Fat % of skim milk powder
mat[3]	SS % of milk
mat[4]	SS % of cream/butter
mat[5]	SS % of skim milk powder
mat[6]	Coefficient of X in Eq.(III)
mat[7]	Coefficient of Y in Eq.(III)
mat[8]	Coefficient of Z in Eq.(III)
con[1]	R.H.S. of Eq. (I)
con[2]	R.H.S. of Eq. (II)
con[3]	R.H.S. of Eq. (III)

gmat[] is used to store different matrices required for calculation.

T[] is used to store the values of X, Y and Z.

Program :

```
main()
{
float mat[9],con[9],t[9],gmat[9];
int i,k,l,c;
float j,fm,sm,sg,ss,x,y,z,val,det,temp;
clrscr();
for (i=0;i<=8;i++)
{
mat[i]=0.0;
con[i]=0.0;
t[i]=0.0;
gmat[i]=0.0;
}
fm=0.0;
sm=0.0;
sg=0.0;
ss=0.0;
j=0.0;
printf("REQUIRED ICE CREAM MIX COMBINATION\n");
printf("————————————————————————\n");
printf("Enter the required kg. of ice cream ");
scanf("%f",&j);
printf("Enter the required FAT percentage of ice cream mix ");
scanf("%f",&fm);
printf("Enter the required serum solids percentage of Mix ");
scanf("%f",&sm);
printf("Enter the required Sugar percentage of Mix ");
```

```
scanf("%f",&sg);
printf("Enter Stabilizer/Emulsion percentage of Mix ");
scanf("%f",&ss);
printf("————————————————————\n");
printf("\n");
printf("TEST DATA OF MILK, CREAM AND SKIM MILK POWDER\n");
printf("————————————————————\n");
printf("Enter FAT percentage of Milk ");
scanf("%f",&mat[0]);
printf("Enter SS percentage of Milk ");
scanf("%f",&mat[3]);
printf("Enter FAT percentage of Cream/Butter ");
scanf("%f",&mat[1]);
printf("Enter SS percentage of Cream/Butter ");
scanf("%f",&mat[4]);
printf("Enter FAT percentage of Skim Milk Powder ");
scanf("%f",&mat[2]);
printf("Enter SS percentage of Skim Milk Powder ");
scanf("%f",&mat[5]);
for (i=6;i<=8;i++)
mat[i]=1;
con[1]=fm*j;
con[2]=sm*j;
con[3]=j-sg/100*j-ss/100*j;
temp=mat[0]*(mat[4]*mat[8]-mat[7]*mat[5])-mat[1]*(mat[3]*mat[8]-mat[6]*mat[5])+mat[2]*(mat[3]*mat[7]-mat[6]*mat[4]);
det=temp;
for (k=0;k<=2;k++)
{
c=1;
for (l=0;l<=8;l++)
{
gmat[l]=mat[l];
}
for (i=k;i<=8;i=i+3)
{
gmat[i]=con[c];
c++;
}
temp=gmat[0]*(gmat[4]*gmat[8]-gmat[7]*gmat[5])-gmat[1]*(gmat[3]*gmat[8]-gmat[6]*gmat[5])+gmat[2]*(gmat[3]*gmat[7]-gmat[6]*gmat[4]);
t[k]=temp;
}
x=t[0]/det;
y=t[1]/det;
z=t[2]/det;
clrscr();
printf("————————————————————\n");
printf("        FORMULATION OF ICE CREAM MIX\n");
printf("————————————————————\n");
printf("INGREDIENT          QUANTITY\n");
printf("————————————————————\n");
printf("MILK        :        %5.2f kg\n",x);
printf("BUTTER      :        %5.2f kg\n",y);
printf("S M P       :        %5.2f kg\n",z);
printf("SUGAR       :        %5.2f kg\n",sg);
printf("STABILIZER  :        %5.2f kg\n",ss);
printf("————————————————————");
getch();
  }
```

RESULTS AND DISCUSSION

Conventional method of figuring the selected dairy and non-dairy ingredients for making ice cream mix is a complex and time consuming process. Error in calculation leads to deterioration in quality of ice cream, increase in the cost of production of ice cream besides inviting legal complications. This programme is user friendly and help in properly balancing a mix, in establishing and maintaining uniform quality and in producing ice cream that conforms to legal standards.

Execution of the program:

Execution of the program allows us to input the required items needed for the calculation and provides the necessary output.

From the output it is clear that 67.92 kg of milk, 13.40kg of butter, 3.87 kg of SMP, 14.50 kg of sugar and

Input	
Required ice cream mix combination	
Enter the required kg. of ice cream	100.0
Enter the required fat percentage of ice cream mix	10.0
Enter the required serum solids percentage of mix	11.0
Enter the required sugar percentage of mix	14.5
Enter Stabilizer /Emulsion percentage of mix	0.3
Test data of milk, cream and skim milk powder	
Enter fat percentage of milk	6.8
Enter SS percentage of milk	9.6
Enter fat percentage of cream/butter	40.0
Enter SS percentage of cream/butter	5.4
Enter fat percentage of skim milk powder	0.5
Enter SS percentage of skim milk powder	97.0

Output	
Formulation of ice cream mix	
Ingredient	Quantity
Milk	67.92 kg
Butter	13.40 kg
S.M.P.	3.87 kg
Sugar	14.50 kg

0.30 kg of stabilizer were required to form 100kg of ice cream maintaining the required combination of ice cream mix. Using this program, we can find the combination of any amount of Ice Cream Mix.

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