***Original Research Article***

**GHP TRAINING IMPACT AND TRAINING NEED ANALYSIS IN A LARGE-SCALE AUTOMATED BISCUIT FACTORY**

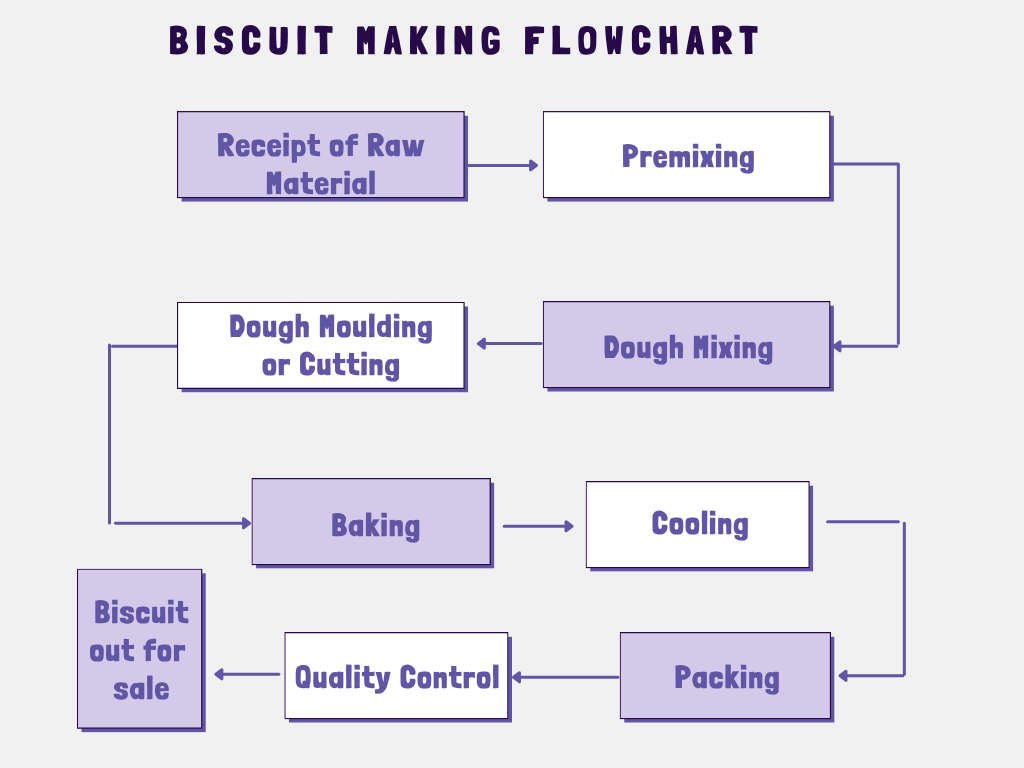
**ABSTRACT**

Factory hygiene, personnel hygiene, and product handling are the keys to minimizing the risk of foreign particles and microbial contamination in biscuits. The present study aims to first understand the age group of associates working on the production floor and self-assessed knowledge of GHP in different age groups and finally assess GHP practice and specific training needs of associates working in an automated Biscuit manufacturing unit. A survey through a questionnaire has been conducted among 156 associates working on the manufacturing floor in two Automated Biscuit factories located in Bhubaneswar, Odisha, India. It is found that the age group of 19 to 42 comprises 90.38% of the workforce. With the increase of age of associates more and more participation in training was observed and their self-assessed knowledge also increased. However, when the actual GHP practice weightage of an age group was compared with the average knowledge grading or training weightage of factory associates of the same age group, no significant correlation was found. Further, most experienced and most trained associates of the age group 50 to 60 did not follow Good Hygiene Practices. Though training is important in enhancing the knowledge and confidence of the associates it may not always bring about the desired level of hygiene practice. Strict supervision, regular monitoring and innovative technique of training are equally important to achieve the required goal. The importance of hygiene in automated lines must invariably be a part of the training curriculum.

**Key Words: Food Contaminations, GHP, Training Need Analysis, Hygiene Practice Weightage.**

# INTRODUCTION

Biscuit making process in a large-scale factory is highly automated and requires limited human handling in the production process. Different personnel involved in the manufacturing of biscuits in large factories are employed in the Production, Quality, and Maintenance departments. The manufacturing unit of a biscuit factory generally has four parts. These four parts according to process flow are (a) Pre-mixing, Mixing, and Moulding unit, (b) Baking and Cooking unit, (c) Packing and Storing unit, (d) Testing, Quality Control, and Printing unit. Machine Operators, Bakers, Mechanics, Minders, Mixing Men, Cleaners, helpers, Quality Officers, FSMS coordinators, Lab chemists, Microbiologist, Packers and General Workers are generally employed in a large-scale biscuit manufacturing line.



**Figure-1: Biscuit manufacturing flowchart in an automated biscuit factory**

Regular cleaning and disinfection of equipment, surfaces, and production floor is of prime importance in an automated biscuit factory. In the Premixing, mixing, and dough molding process foreign particles can enter into the production line from raw materials as well as personal belongings of the factory associates. While microbial contamination can occur in dough mixing, molding, and cooling processes from the factory associates as well as from surfaces of the equipment. Though the high temperature in baking kills some microorganisms, some may still persist. The biscuit manufacturing workflow in an automated biscuit factory is presented in Figure-1.

As such, factory hygiene, personnel hygiene, and product handling are the keys to minimizing the risk of foreign particles and microbial contamination in biscuits. Here lies the importance of well-trained and knowledgeable factory associates in the biscuit production line. Different training programs including GHP training play an important role in enhancing the knowledge of factory associates. (Tuglo, L.S., Agordoh, P.D., Tekpor, D. et al. 2021 ;Osimani et al.2011). On the contrary adequate training and knowledge of GHP and GMP does not always bring about a positive change in the behaviors of factory associates which may unknowingly cause contaminations in biscuits. (Angelillo, Viggiani, Greco, &Rito, 2001; Araujo, Ramos, & Cardoso, 2007; Bas, Ersun, &KivanÇ, 2006; Walker, Pritchard, & Forsythe, 2003).

In the present study, a survey was conducted among associates working in a biscuit manufacturing line to understand the training program on hygiene (GHP) conducted in the factory, the knowledge of associates, and their actual practice in a biscuit factory. This will also help to assess training needs.

1. **MATERIAL AND METHOD**

**2.1. Area of Study**

A survey has been conducted among 156 associates working on the manufacturing floor in two Biscuit factories located in Bhubaneswar, Odisha, India, one with strength of employees 84 and the other 72, and involved in the manufacture of different types of biscuits, and cookies in an automated process. The knowledge and expertise of GHP among workers of the factory were studied to understand past training impact and to assess the training needs of associates for hygiene improvement.

In the survey associates entering into the manufacturing area i.e. Machine Operator, Baker, Mechanic, Minder, Mixing Man, Cleaner, helper, Quality Officer, FSMS Coordinator, Lab Chemist & Microbiologist, Packers, and General Workers are selected for the study.

**2.2. The period of study**

One light-duty break hour over three weeks in the month of January 2025 was selected.

**2.3. Tools for data collection: survey**

# A survey was conducted among factory personnel through personal interviews using a questionnaire on GHP. Survey questionnaires were designed to give answers in yes or no format to make the matter simple, short and to assess their first-hand reaction. The questions were developed with the help of literature review on food hygiene practices and were in agreement with the hygiene question framework as opined by Ulusoy, B.H., Çolakoğlu, N. (2018) , Jee Hye Lee and Kyung Hwa Seo (2020) and Tuglo et. al.(2021). Though factory hygiene and personal hygiene are two components of GHP, which in many aspects are interdependent but the present study focuses only on personal hygiene practices. Practice of proper hand washing, cleanliness, head covering, gloves and mask use, eating and smoking habits were stressed upon. Foreign particle contamination in biscuit is caused by factory cleanliness and carrying prohibited items like cigarette, bidi in the production area. As such, the same was included in the survey questionnaire.

To access whether the proper hand washing techniques were followed or not, a picture of the proper hand washing techniques of rubbing soap in the palm, back of the palm, between fingers, nails, and bade of thumb was shown and the associates were asked whether the same is being followed. The survey also aims at understanding the age group of associates, their knowledge of GHP in their own assessment, the number of training undertaken in the past 3 years, and their hygiene practices. To assess the training weightage index on a maximum scale of 4, a person with more than 8 training in the last 3 years was awarded 4 points,5-6 with 3, 2-4 with 2, and 0-1 was awarded 1 point. In order to assess the weightage of hygiene practice, different hygiene practices were awarded 4 points only when the response was in the affirmative. The absence of such practice or reply in negative will attract a null value. Then sum total of such points divided by the number of such employees in that age group yielded the Average Hygiene Practice Weightage index.

The average knowledge gradient was computed on the basis of the weightage of knowledge of factory associates on GHP, as opined by the associates themselves in the survey. When each associate responded with very good they were assigned 4 points, for good 3, for moderate 2, and for poor knowledge, 1 point was assigned. The sum total of such points divided by the number of employees of an age group yielded the average knowledge gradient of that age group. These data were utilized to compare knowledge and practice among different age groups.

**2.4. Limitation of research:**

The study was conducted only on associates employed in the automated Biscuit manufacturing Industry in the Bhubaneswar area who are directly involved in the manufacturing process and based on their feedback and self-assessment. It focuses on Good Hygiene practices by associates without any further change in factory set-up or mechanization. The sample size is limited to only 156 for two factories, which is only representative.

1. **RESULT AND DISCUSSION:**

**3.1. Training impact assessment**

It is clear from the survey that the majority of associates in the factory manufacturing area are in the age group of 19 to 42 comprising 90.38% of the workforce. Within this age range, maximum

associates were in the age group of 25-30 years followed by 31 to 36 years. New recruits in the age range of 19-24 years constitute about 17.31 % of the workforce.

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**Figure 2: Age of factory associates Figure 3: Average training weightage Vrs GHP weightage**

**Working in the production floor**

From the data of the number of training received and Average Training Weightage obtained by dividing total training weightage by number of associates in that age group, as shown in Table-1, it is evident that only one in the age group of 19-24 has received 8 or more training in the last three years which is quite consistent with the fact that newly recruited associates belong to this age group.

**Table -1: Number and weightage of training undertaken by associates of different age group**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Age group  ( A ) | Number of associates  (A1) | 0-2 training received in last 3yrs  (B ) | Weightage of training  B\* 1  ( C ) | 3-4 training received in last 3yrs  ( D ) | Weightage of training  D\*3.5  ( E) | 5-7 training received  in last 3yrs  (F) | Weightage of training  F\* 6  ( G ) | 8 or more training received  in last 3yrs  (H) | Weightage of training H\*8  (I) | Total weightage of age group  (J) | Average training weightage  J/A  (K) |
| 19-24 | 27 | 16 | 16 | 7 | 24.5 | 3 | 18 | 1 | 8 | 66.5 | 2.46296 |
| 25-30 | 52 | 17 | 17 | 19 | 66.5 | 10 | 60 | 6 | 48 | 191.5 | 3.68269 |
| 31-36 | 41 | 5 | 5 | 6 | 21 | 22 | 132 | 8 | 64 | 222 | 5.41463 |
| 37-42 | 21 | 0 | 0 | 2 | 7 | 4 | 24 | 15 | 120 | 151 | 7.190476 |
| 43 -48 | 9 | 0 | 0 | 0 | 0 | 3 | 18 | 6 | 48 | 66 | 7.33333 |
| 49-54 | 5 | 0 | 0 | 0 | 0 | 1 | 6 | 4 | 32 | 38 | 7.6 |
| 55-60 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 8 | 8 | 8 |
| Total | 156 | 38 |  | 34 |  | 43 |  | 41 |  |  |  |

From the same data set in Table -1, it appears that some associates in the age group of 25-30 and 31-36 have received less than 2 training in the last 3 years indicating that they were also recruited in the recent past or the system of GHP training was not prevalent in the previous organization they absent on training day or training was not compulsory. As expected, with the increase in age of associates more participation in training was observed (Figure 4), and a positive correlation at P = 0.0018 which is lower than 0.05 (P<0.05), statistically significant at 5% level was found out. However, the fact that all personnel in the age group of 43 - 48 and 49 -54 did not participate in more than 8 training in the last 3 years indicates the absence of employees on the training date or that training was not compulsory.

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**Figure 4: Age of factory associates and training weightage Figure 5:Age of factory associates and knowledge gradient**

The average knowledge gradient was computed by allowing weightage on knowledge of factory associates on GHP as opined by the associates themselves which is presented in Table 2. Average Knowledge Grading (AKG) is obtained by dividing Total Training Weightage by number of associated in that group.

**Table 2: Rating of GHP knowledge as Very Good, Good, Moderate,Poor &assigning grading thereof**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Age group of associates  ( A) | Total employees  (B) | No who rated knowledge as Very good( 4)  ( C ) | Weightage  C\*4  ( D ) | No who rated knowledge as good  ( 3)  ( E ) | Weightage  E\*3  ( F ) | No who rated knowledge as Moderate(2)  ( G ) | Weightage  G\*2  (H ) | No who rated knowledge Poor (1)  ( I ) | Weightage  I\*1  ( J ) | Total Knowledge  Weightage  (K) | Average  knowledge Grading K/B  (L) |
| 19-24 | 27 | 1 | 4 | 2 | 6 | 10 | 20 | 14 | 14 | 44 | 1.6296 |
| 25-30 | 52 | 7 | 28 | 8 | 24 | 18 | 36 | 19 | 19 | 107 | 2.05769 |
| 31-36 | 41 | 9 | 36 | 17 | 51 | 13 | 26 | 2 | 2 | 115 | 2.80488 |
| 37-42 | 21 | 12 | 48 | 6 | 18 | 3 | 6 | 0 | 0 | 72 | 3.42857 |
| 43 -48 | 9 | 5 | 20 | 3 | 9 | 1 | 2 | 0 | 0 | 31 | 3.44444 |
| 49-54 | 5 | 3 | 12 | 2 | 6 | 0 | 0 | 0 | 0 | 18 | 3.6 |
| 55-60 | 1 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 |
| Total | 156 | 38 |  | 38 |  | 45 |  | 35 |  |  |  |

As expected with increase of age self-assessed knowledge increased and is highest with age group 55-60. AKG is 4 for that age group 66-60 and is the lowest with age group 19-24 at 1.6296. Majority of associates (45, i.e. 28.84%) graded their knowledge in GMP as moderate whereas 24.35 % graded their knowledge as Very Good and Good (both 38). Figure 5 indicates the relationship between the age of factory associates and knowledge gradient which, shows similarity to Figure 4 but a better positive correlation (r = 0.95735) at P = 0.0007 (P<0.05) statistically significant at 5% level, indicating that with an increase of age both number of training and knowledge increases, as expected.

When Average Training Weightage is compared with the average knowledge gradient (Figure 6) a highly positive correlation was found to exist (r = 0.993975, with P < 0.0001 at 5% level). The average knowledge gradient is obtained by the self-assessment survey is also quite expected to increase with more training and the age of the associates as with the increase in participation in the GHP training program factory associates feel more confident about their knowledge in GHP. The graph in Figure 6 shows an almost perfect leaner relationship.

**Figure 6:Age of factory associates and knowledge Figure 7:Age and Average Hygiene practice weightage**

But when the Average Hygiene Practice Weightage (AHPW) of an age group was compared with the average knowledge grading of factory associates of the same age group with P = 0.5198 (P>0.05) no statistically significant correlation at 5% level was found (Figure 8). AHPW is computed by dividing total GHP practice weightage, (obtained by allowing weightage of 4 to each GHP) by number of associates in that age group. As expected the youngest associates belonging to the age group of 10-24 exhibited the least hygiene practice. This may be due to a lack of training and knowledge. Details of GHP practice data are presented in Table 3.

**Table 3: Data showing actual number of associates following required GHP, different age group wise and GHP practice weightage computation.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Age group  (A) | Total associates  (B) | Positive practice : Clean outer clothing used every day  (number)  ( C ) | Percentage  ( %)  &  weightage (C\*4)  (D) | Positive practice:  Always wash hand each time after returning from Toilet(no)  (number)  ( E) | Percentage (%)  &  weightage (E\*4)  (F) | Positive practice;  Use of clean Apron every day  (number)  (G) | Percentage  (%)  &  weightage (G\*4)  (H) | Positive practice;  Always wear head cap cover  (number)  ( I) | Percentage  (%)  &  weightage (I\*4)  (J) |
| 19-24 | 27 | 11 | (40.8%) 44 | 21 | (77.8%) 84 | 15 | (55.6%)60 | 24 | (88.9%)96 |
| 25 30 | 52 | 38 | (73.1%) 152 | 47 | (90.4%) 188 | 43 | (82.7%)172 | 50 | (96.1%) 200 |
| 31-36 | 41 | 25 | (60.9%) 100 | 38 | (92.7%) 152 | 37 | (90.2%) 148 | 41 | (100%)164 |
| 37-42 | 21 | 14 | (66.7%) 56 | 19 | (90.5%) 76 | 10 | (47.6%) 40 | 17 | (80.9%) 68 |
| 43 -48 | 9 | 3 | (33.3%) 12 | 8 | (88.9%) 32 | 8 | (88.9%)32 | 9 | (100%) 36 |
| 49-54 | 5 | 3 | (60%) 12 | 5 | (100%) 20 | 2 | (40%) 8 | 4 | (80%)16 |
| 55-60 | 1 | 1 | (100%) 4 | 1 | (100%) 4 | 0 | (0%) 0 | 1 | (100%) 4 |
| Positive practice;  Not smoking or eating in production area  (number)  (K) | Percentage  ( %)  &  Weightage  (K\*4)  (L) | Positive practice;  Mask cover  (number)  (M) | Percentage  ( %)  &  weightage (M\*4)  (N) | Positive practice;  Following proper procedure in hand washing  (number)  (O) | Percentage  (%)  &  weightage (O\*4)  (P) | Positive practice;  Not carrying Guktha , Biri in factory area  (number)  (Q) | Percentage  (%)  &  weightage (Q\*4)  ( R ) | Positive practice;  Nail cutting every week  (number)  (S) | Percentage  (%)  &  weightage (S\*4)  (T) |
| 11 | (40.7%) 44 | 3 | (11.1%) 12 | 0 | (0%) 0 | 23 | (85.2%) 92 | 20 | (74%) 80 |
| 38 | (73%) 152 | 18 | (34.6%) 72 | 11 | (21.8%) 44 | 47 | (90.4%) 188 | 47 | (90.4%) 188 |
| 25 | (60.9%) 100 | 15 | (36.6%) 60 | 10 | (24.4%) 40 | 39 | (95.1%) 156 | 37 | (90.2%) 148 |
| 14 | (66.6%) 56 | 5 | (23.8%) 20 | 6 | (28.6%) 24 | 20 | (95.2%) 80 | 18 | (85.7%) 72 |
| 3 | (33.3%) 12 | 1 | (11.1%) 4 | 2 | (22.2%) 8 | 9 | (100%) 36 | 9 | (100%) 36 |
| 3 | (60%) 12 | 0 | (0%)0 | 1 | (20%) 4 | 5 | (100%) 20 | 5 | (100%) 20 |
| 1 | (100%) 4 | 0 | (0%)0 | 0 | (0%) 0 | 1 | (100%) 4 | 1 | (100%) 4 |
| Positive practice;  Always wash hand before entering production area  (number)  (U) | Percentage  ( %)  & weightage (U\*4)  (V) | Positive practice;  Always cover nose ,mouth while sneezing &  Coughing  (number)  (W) | Percentage  (%)  &  weightage  (W\*4)  (X) | Positive practice;  refrain from wearing ornaments ,watch in production area  (number)  (Y) | Percentage  (%)  &  weightage (Y\*4)  (Z) | Positive practice;  Always wear gloves in factory  (number)  AA | Percentage  (%)  &  weightage (AA\*4)  AB | Total GHP practice weightage  AC | Average Hygiene practice weightage  (AC/B)  AD |
| 22 | (81.5%) 88 | 20 | (74.1%) 80 | 27 | (100%) 108 | 25 | (92.6%) 100 | 888 | 32.89 |
| 49 | (94.2%) 196 | 45 | (86.5%) 180 | 52 | (100%) 208 | 51 | (98%) 204 | 2144 | 41.23 |
| 39 | (95.1%) 156 | 37 | (90.2%) 148 | 41 | (100%) 164 | 41 | (100%) 164 | 1700 | 41.46 |
| 19 | (90.5%) 76 | 17 | (80.9%) 68 | 21 | (100%) 84 | 21 | (100%) 84 | 804 | 38.29 |
| 8 | (88.9%) 32 | 7 | (77.8%) 28 | 9 | (100%) 36 | 9 | (100%) 36 | 340 | 37.78 |
| 5 | (100%) 20 | 3 | (60%) 12 | 5 | (100%) 20 | 5 | (100%) 20 | 184 | 36.8 |
| 1 | (100%) 4 | 1 | (100%) 4 | 1 | (100%) 4 | 1 | (100%) 4 | 40 | 40 |

The age group 55-60 has the highest practice (100%) of wearing clean clothes every day followed by age group 37-42 (66.7%), whereas the age group 31-36 wears clean apron every day ( 90.2%). The age group of 31-36, 43 -48 and 55-60 has 100% practice of wearing head cover whereas surprisingly age group of 49-54 has the least practice (80 %) of wearing head cover and in the same matter practice of age group of 19-24 stands at 88.9%. Group of people belonging to age 50 to 60 has the highest practice of washing hands at 100% whereas age group 19 to24 has the least.

Overall the group of 31 to 36 showed maximum Average Hygiene Practice Weightage (AHPW) of 41.46 whereas age group 19 to 24 showed the least (32.89). However, group of associates belonging to age 37 to 60 did not show expected Good hygiene practice. Again, most experienced and most trained associates of 50 to 60 did not follow Good Hygiene Practice (AHPW: 40) which is surprising. However this finding is supported by previous reports by Maryam Ansari-Lariet. al.(2010) which reveals that increased knowledge and even attitudes toward food safety does not always result in positive change in their actual hygiene practice in the factory floor. In another study by Soares et. al.(2016), it was found that knowledge Food handlers did not have positive effect in their attitude (p = 0.371) and practice.

**Figure-8: Plot of Average knowledge grading and Average Hygiene Practice Weightage**

This independence of hygiene practice in a factory on experience and age was also exhibited when hygiene practice weightage was plotted against age (Figure 7) and also when Training weightage was plotted against hygiene practice weightage (Figure 3). Average Hygiene Practice Weightage (AHPW) of factory associates was not dependent on age (P = 0.5466 i.e. P>0.05) and training was not significantly correlated with hygiene practice (P = 0.4550, i.e. P>0.05, ) at 5% level for Figure 7 and Figure 3 respectively which shows that Good Hygiene Practice does not solely depend on age or on number of training.

**3.2. Training Need Analysis**

It is also evident from the survey data that in some aspect, hygiene practice is very low and in some aspects hygiene practice is quite high and satisfactory. Deficiencies noticed must invariably be a part of all future training. The aspect of refraining from wearing ornaments, watch in production area exhibited 100% followings,(Table-3) whereas wearing gloves always in factory production area shows near 100% followings. But when following proper procedure in hand washing was surveyed very poor number of associates of all age group seems to follow the required technique (0% to 28.4 %) with age group 50 to 60 follows the least( 0 to 20%). This may be due to attitude of the associates, lack of training or even lack of the subject or demonstration in training. As such, any future training must include practical demonstration of proper hand washing technique. Use of face Mask cover (0% to 36.6%) was practiced poorly and use of clean apron every day at level of 0% to 90.2% of associates was not satisfactory. 100 % control does not exist in eating and smoking in production area as in age group 43 to 48 the control is 33.3%, in age group 19-24 the control is 40.7%. Emphasis should also be given on these aspects in any future training programme. Associates in the age group of 19 to 24 have least training weightage of 2.65 and they also had undertaken least number of training. As such these associate must be included in future training. Hygiene practice of not carrying Cigarette, Guktha, Biri or other intoxicant in production floor though practiced by more than 90 % associates of all age groups, but is very vital for maintenance of hygiene and product quality as any negligence may lead to contamination of food product which is very detrimental for product quality and reputation of a company. As such associates should be trained for 100% enforcement of this practice.

In an automated biscuit manufacturing line associates may sometimes become more complacent about hygiene due to limited human touch of ingredients and may deviate from what they are trained. As such importance of hygiene in automated line must invariably be a part of training.

As reported by Nandi. S. (2025), associates working in biscuit factory production area find short duration training with practical/pictorial demonstration is more effective. Hence, short duration training with practical demonstration must be followed. If practical demonstration is not possible pictorial/ multimedia demonstration may also be arranged.

Even after conducting regular training for factory associates deficiencies noticed in the practical application may be due to methods used, demographics of trainees and their preparedness to learn, absence of a refresher program, and lack of supervision after training. (Gilling, Taylor, Kane, & Taylor 2001). As such regular refresher courses and new innovative training methods (Jee Hye Lee , Kyung Hwa Seo,2020)should be adopted to keep associates updated and motivated.

1. **CONCLUSION**

The survey is used as an important tool to evaluate knowledge and practice of the factory associates towards GHP and also enable to understand the age group of associates working in the production floor who handle the manufacturing process. This data in turn is utilized to evaluate previous training outcomes and future training needs of the factory associates. Though, the factory understudy showed good Knowledge and practice relating to hygiene some areas involving actual know-how and practice of hand washing showed significant deficiencies. Some areas like not carrying bidi, cigarettes, and Gutkha inside the factory premises though showed good control but need 100% restriction and practice as it is a potential source of contamination. Age and knowledge do not always yield good hygiene practices (GHP) as found in the survey. Training, and multimedia demonstration are important in enhancing the knowledge and confidence of the associates but strict supervision and regular monitoring are also equally important to exercise GHP in a biscuit factory.

**Disclaimer (Artificial intelligence):** Author hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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